United States Department of Agriculture

Soil Conservation Service

In cooperation with Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and Michigan Technological University

Soil Survey of Menominee County, Michigan

How To Use This Soil Survey

General Soil Map

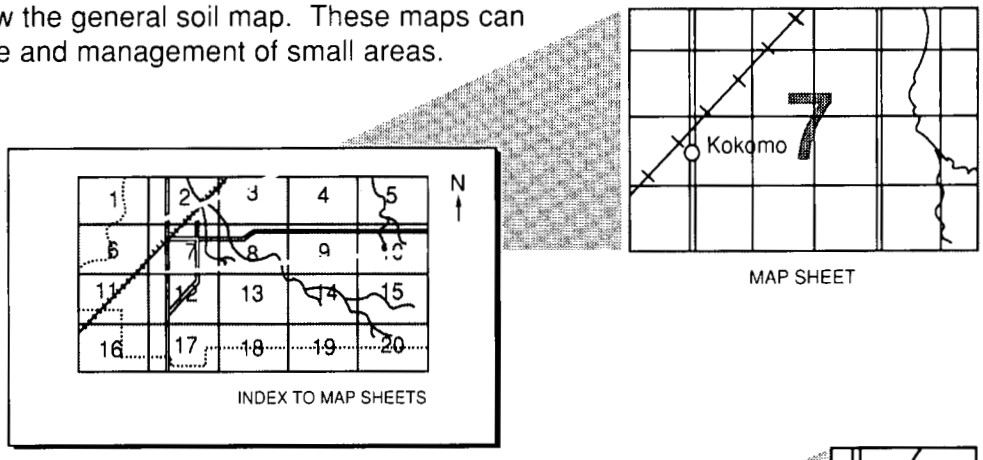
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

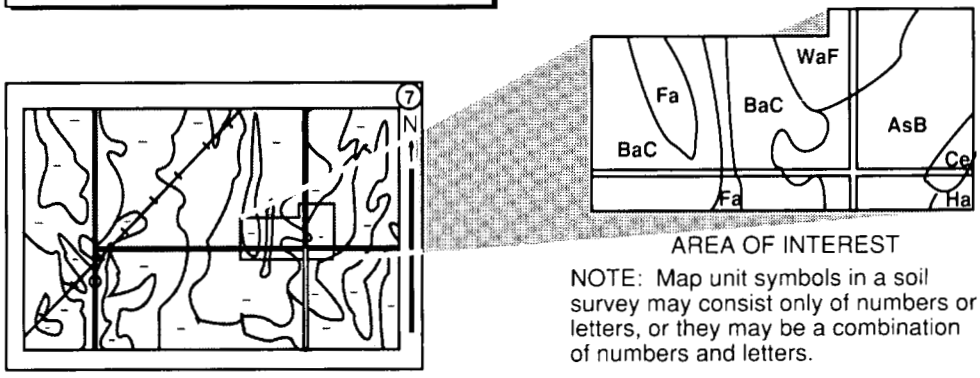
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service, Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and Michigan Technological University. It is part of the technical assistance furnished to the Menominee Soil Conservation District. Financial assistance was made available by the Menominee County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: An area of Onaway and Lupton soils.

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Foreword

This soil survey contains information that can be used in land-planning programs in Menominee County, Michigan. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Homer R. Hilner
State Conservationist
Soil Conservation Service

Location of Menominee County in Michigan.

Soil Survey of Menominee County, Michigan

By Charles Schwenner, Soil Conservation Service

Fieldwork by Loren Berndt, Joseph Calus, Larry Carey, Thomas Purkey, Jon Quisler, Stephen Rodock, Charles Schwenner, and Anthony Smith, Soil Conservation Service, and Thomas Bauer, Michigan Department of Agriculture

United States Department of Agriculture, Soil Conservation Service, in cooperation with
Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and Michigan Technological University

MENOMINEE COUNTY is in the south-central part of the Upper Peninsula of Michigan. The county is bordered on the north by Marquette County, on the northwest by Dickinson County, on the northeast by Delta County, on the east by Lake Michigan, and on the west and south by the Menominee River, which separates the county from Wisconsin. The total area of the county is 668,979 acres, or about 1,045 square miles. Menominee is the county seat. The population of the county was 25,603 in 1980.

About 75 percent of the county is forested, 19 percent is used for agricultural purposes, and 6 percent is used as urban or built-up land (*14*). Farming and forestry are the two main economic enterprises in the county.

This survey updates the soil survey of Menominee County published in 1925 (*8*).

General Nature of the County

This section gives general information about the county. It describes climate, history and development, physiography, lakes and streams, and farming.

Climate

Prepared by the Michigan Department of Agriculture, climatology division, East Lansing, Michigan.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Stephenson and Cornell, Michigan. Table 2 gives data on precipitation at Spalding. Tables 3 and 4 show probable dates of the first freeze in fall and the last freeze in spring. Tables 5 and 6 provide data on length of the growing season. Data in tables 4 and 6 were recorded inland at Iron Mountain in adjacent Dickinson County and along Lake Michigan at Escanaba in adjacent Delta County. They are representative of inland and lakeshore areas in Menominee County.

In winter the average temperature is 17.6 degrees F at Stephenson and 17.2 degrees at Cornell, and the average daily minimum temperature is 7.8 degrees at Stephenson and 7.3 degrees at Cornell. The lowest temperature on record is -35 degrees at Stephenson and -29 degrees at Cornell. In summer the average temperature is 65.2 degrees at Stephenson and 63.6 degrees at Cornell, and the average daily maximum temperature is 78.2 degrees at Stephenson and 76.9 degrees at Cornell. The highest recorded temperature is 101 degrees at Stephenson and 97 degrees at Cornell.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop

between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 32.63 inches at Stephenson, 32.80 inches at Cornell, and 30.14 inches at Spalding. Of these totals, 21.04 inches at Stephenson, 21.73 inches at Cornell, and 20.09 inches at Spalding usually fall in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17.4 inches at Stephenson, 17.5 inches at Cornell, and 16.8 inches at Spalding. The heaviest 1-day rainfall during the period of record was 4.32 inches at Stephenson on June 7, 1968; 3.26 inches at Cornell on August 16, 1978; and 4.57 inches at Spalding on August 21, 1959. Thunderstorms occur on about 32 days each year at Stephenson and Spalding and on about 31 days each year at Cornell.

The average seasonal snowfall is 65.3 inches at Stephenson, 61.7 inches at Cornell, and 66.0 inches at Spalding. The greatest snow depth at any one time during the period of record was 35 inches at Stephenson, 39 inches at Cornell, and 43 inches at Spalding. On the average, 110 days of the year at Stephenson and Spalding and 120 days at Cornell have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The highest seasonal snowfall was 106.7 inches during the winter of 1970-71 at Stephenson, 92.7 inches during the winter of 1978-79 at Cornell, and 117.8 inches during the winter of 1970-71 at Spalding. The lowest seasonal snowfall was 25.5 inches during the winter of 1943-44 at Stephenson, 22.0 inches during the winter of 1962-63 at Cornell, and 26.0 inches during the winter of 1963-64 at Spalding. The highest monthly snowfall was 43.8 inches in January 1971 at Stephenson, 40.0 inches in January 1971 at Cornell, and 45.8 inches in December 1968 at Spalding. The heaviest 1-day snowfall on record was 15.0 inches on January 4, 1971, at Stephenson; 12.5 inches on February 12, 1965, at Cornell; and 12.8 inches on March 24, 1975, at Spalding.

The average relative humidity in midafternoon is about 63 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the southwest (*3*).

History and Development

The original inhabitants of the survey area were the Menominee Indians. The name "Menominee" was coined by the early French explorers, who observed that the Indians prepared their meals with wild rice, which grew in abundance near the mouth of the Menominee River. The Indian term for wild rice was "mah-ma-ma-nam-ee," so the tribe became known as the Menominees, or "wild rice gatherers."

French explorers and missionaries were the first Europeans to reach the mouth of the Menominee River. The French claimed the area from 1634, when French explorer Jean Nicolet first arrived, until 1763, when the area was claimed by the British as a result of the French and Indian wars.

The first permanent European settlers in the survey area were fur traders, who established a trading post near the present-day city of Menominee in 1796. Trading with the Indians remained the principal economic activity until 1831, when the first water-powered sawmill was constructed. The construction of steam-powered sawmills in 1856 began a period of rapid development. Ample natural resources, inexpensive shipping via the Great Lakes, and expanding markets in the Chicago and Milwaukee areas accelerated the development. Millions of feet of white pine timber were cut within the watershed of the Menominee River, which provided an excellent means of transporting the softwood logs to the sawmills at the mouth of the river. The logging peaked in 1889, when 27 sawmills operated in the city of Menominee. The supply of timber along the Menominee River and its main tributaries was exhausted by 1917, when the final log drive on the river occurred.

Menominee County was organized in 1863. As late as 1872, however, the interior of the county was an undeveloped wilderness covered with large tracts of mature hardwood forests. The first agricultural endeavors were located along the Menominee River. Many of these early farms were operated by the lumber companies. They supplied the logging camps with food for the horses and lumberjacks. The first roads through the interior of the county were built in 1867, and a railroad was extended from Menominee to Escanaba in 1872.

Once the means for transporting people and products were in place, the interior of Menominee County was developed rapidly. The hardwood forests provided raw material for the new hardwood flooring mill at Hermansville and for the production of charcoal, which was used in the smelting of iron ore that was being mined in the northwestern part of the county. After the pine sawtimber became scarce, new industries, such as foundries, papermaking mills, and furniture factories, which could utilize the hardwood resource, took the place of the sawmills.

The settlers discovered that the soils could be used for agricultural crops. Agriculture, mainly dairy farming, became a significant part of the local economy as the land was cleared. Dairy farming and logging, as well as industries that process and transport milk and wood, are still the mainstays of the economy.

Physiography

The surface features of Menominee County were formed by the most recent glacier to occupy the area, the Wisconsin glacier. Recession of the portion of the glacier that covered Michigan began about 14,000 years ago and was completed about 8,000 years ago.

The county has three main physiographic regions. The first consists of sandy lacustrine deposits in the area adjacent to Green Bay. This region makes up about 9 percent of the county. It was once the lakebed of ancient Lake Algonquin. It is characterized by poorly drained and somewhat poorly drained, sandy soils interspersed with narrow, winding ridges of well drained, windblown sand. The old lake plain is 3 to 7 miles wide. It is narrowest near the city of Menominee and gradually increases to a width of 7 miles at the border of Delta County.

The second physiographic region is a rolling ground moraine in the central part of the county. It consists mainly of glacial till plains interspersed with large areas of organic soils and outwash plains. This region makes up about 84 percent of the county. Most of it, especially the northern and central parts, is characterized by numerous parallel, elongated ridges of compact glacial till, or drumlins. These drumlins range from one-quarter mile to more than a mile in length, are oriented from northeast to southwest, and feature loamy, well drained soils. In many areas the drumlins lie close together and are separated by deep V-shaped valleys. The base of these valleys generally is filled with deposits of organic material 1 foot to several feet thick.

The third physiographic region is an end moraine in the west-central part of the county, adjacent to the Menominee River. This region makes up about 7 percent of the county. It is underlain by sandstone bedrock, whereas the remainder of the county is underlain by a thick sheet of limestone over sandstone. As a result, the soils in this region are more acidic and coarser textured and have numerous erratics of different geologic origin. The western border of this moraine is an alluvial flood plain made up of material deposited by the Menominee River. Along the eastern edge of the moraine is an apron of outwash, consisting of sand and gravel that was deposited as the ice melted.

Elevation in Menominee County ranges from 580 feet above sea level on the lacustrine plain near Menominee to nearly 1,100 feet above sea level on the end moraine in the northwestern part of the county.

Lakes and Streams

Menominee County has three main drainage systems, which empty into Lake Michigan. These are the Menominee, Big Cedar, and Ford Rivers. The Menominee River flows southward and forms the boundary separating Menominee County from Marinette County, Wisconsin. It drains the west-central and southern parts of Menominee County. The Big Cedar River flows southeasterly and drains the northwestern and east-central parts of the county. The Ford River flows southeasterly and drains the northern part.

Approximately 50 scattered lakes are throughout the county. Most of them are shallow "bog lakes."

Farming

The first farms in Menominee County were established in areas along the Menominee River where the land was first cleared by loggers. Following the construction of a railroad through the center of the county in 1872, many farms were established on the productive soils in that part of the county. The principal crops were hay, oats, and potatoes.

The number of farms increased rapidly from 316 in 1880 to 2,106 in 1920. Since 1920, the total farm acreage and the number of farms have decreased, but the average farm size has increased steadily because of the consolidation of the smaller farms.

Approximately 130,000 acres in the county, or 19 percent of the land area, currently is or formerly was used for agricultural products. Of this acreage, 90,000 acres is classified as cropland and the remaining 40,000 acres either is permanent pasture and hayland or is idle land (*14*).

The dominant form of agriculture in Menominee County is dairy farming, although there are some small livestock enterprises. Dairy farming is well suited to the short growing season. The principal crops are corn, alfalfa, and small grain, most of which are used as feed for dairy cows and livestock.

The Menominee County Soil Conservation District was formed in 1944 to assist landowners in preventing excessive erosion and pollution.

The combined factors of productive soil, northern climate, and current economic conditions indicate that the future economy of Menominee County will be based largely on agriculture.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other

living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures followed in making this survey are described in the National Soils Handbook and the *Soil Survey Manual* (*10*) of the Soil Conservation Service.

Before traversing the landscape, soil scientists compared each map sheet to the USGS topographic map for the area and stereoscopically plotted preliminary boundaries of slopes and landforms on 1:20,000 leaf-off aerial photographs. Some traverses were made by truck or trail bike on the existing network of roads or trails, but most were made on foot, at intervals of about one-fourth mile. Traverses or random observations were made at closer intervals in areas of high variability.

Soil examinations along the traverses were made wherever obvious soil boundaries were crossed. Observations of such items as landforms, blowndown trees, vegetation, roadbanks, and rock outcrops were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of a hand auger, push probe, or a spade to a depth of about 5 feet or to bedrock within a depth of 5 feet. The pedons described as typical were observed and studied in pits.

Samples for chemical and physical analyses were taken from the sites of the typical pedon for some of the major soils in the survey area. The analyses were made by the National Soil Survey Laboratory at Lincoln, Nebraska, and by the Soil Research Laboratory, Ford Forestry Center, Michigan Technological University, L'Anse, Michigan. The results of the analyses are stored in a computerized data file at the laboratories. The results and a description of the laboratory procedures can be obtained on request from the laboratories.

After the completion of the soil mapping, map unit delineations were transferred by hand to leaf-on orthophotographs at a scale of 1:20,000. Surface drainage and cultural features were recorded from visual observations.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions, names, and delineations of the soils on the general soil map of this survey area do not fully match or agree with those of the soils on older maps of adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in concepts of soil series, and variations in the intensity of mapping or in the extent of the soils in the survey areas.

Soil Descriptions

1. Deford-Wainola-Rousseau

Deep, nearly level to hilly, poorly drained, somewhat poorly drained, and well drained, sandy soils on lake plains and outwash plains

This map unit consists of soils on broad flats, knolls, and elongated ridges and in drainageways and depressions. Slopes range from 0 to 25 percent.

This map unit makes up about 9 percent of the county. It is about 35 percent Deford soils, 30 percent Wainola soils, 15 percent Rousseau soils, and 20 percent minor soils (fig. 1).

The Deford soils are in depressions and drainageways and are poorly drained. They are nearly level. Typically, the surface layer is about 7 inches of black muck and mucky fine sand. The substratum to a depth of about 60 inches is fine sand. It is grayish brown and mottled in the upper part and brown and dark reddish brown in the lower part.

The Wainola soils are on the slightly higher broad flats and are somewhat poorly drained. They are nearly level. Typically, they have about 2 inches of black, well decomposed organic material at the surface. The surface layer is pinkish gray fine sand about 10 inches thick. The subsoil is mottled fine sand about 29 inches thick. The upper part is reddish brown and very friable, the next part is strong brown and very friable, and the lower part is brown and loose. The substratum to a depth of about 60 inches is brown very fine sand.

The Rousseau soils are on knolls and elongated ridges and are well drained. They are undulating to hilly. Typically, they have about 1 inch of black, well decomposed forest litter at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand.

Minor in this map unit are the Lupton, Tawas, Burleigh, Pickford, Solona, Rousseau, Nadeau, and Onaway soils. Burleigh, Pickford, Solona, Nadeau, and Onaway soils are more slowly permeable than the major soils. The very poorly drained Lupton and Tawas soils are in depressions. The poorly drained Burleigh and Pickford soils are in depressions, on low flats, and in drainageways. The somewhat poorly drained Solona and moderately well drained Rousseau soils are on flats. The well drained Nadeau and Onaway soils are on ridges and knolls in the uplands.

This map unit is used mainly as woodland or wildlife habitat. The equipment limitation, the windthrow hazard, seedling mortality, and plant competition are concerns in managing woodland. Also, water erosion is a hazard on the rolling and hilly Rousseau soils. Crops generally are not grown on this map unit because of wetness and a scarcity of drainage outlets in the lower areas and droughtiness in the more sloping areas.

2. Solona-Pickford-Cathro

Deep, nearly level, somewhat poorly drained to very poorly drained, loamy, silty, and mucky soils on moraines and lake plains

This map unit consists of soils on broad flats and in depressions and drainageways. Slopes range from 0 to 3 percent.

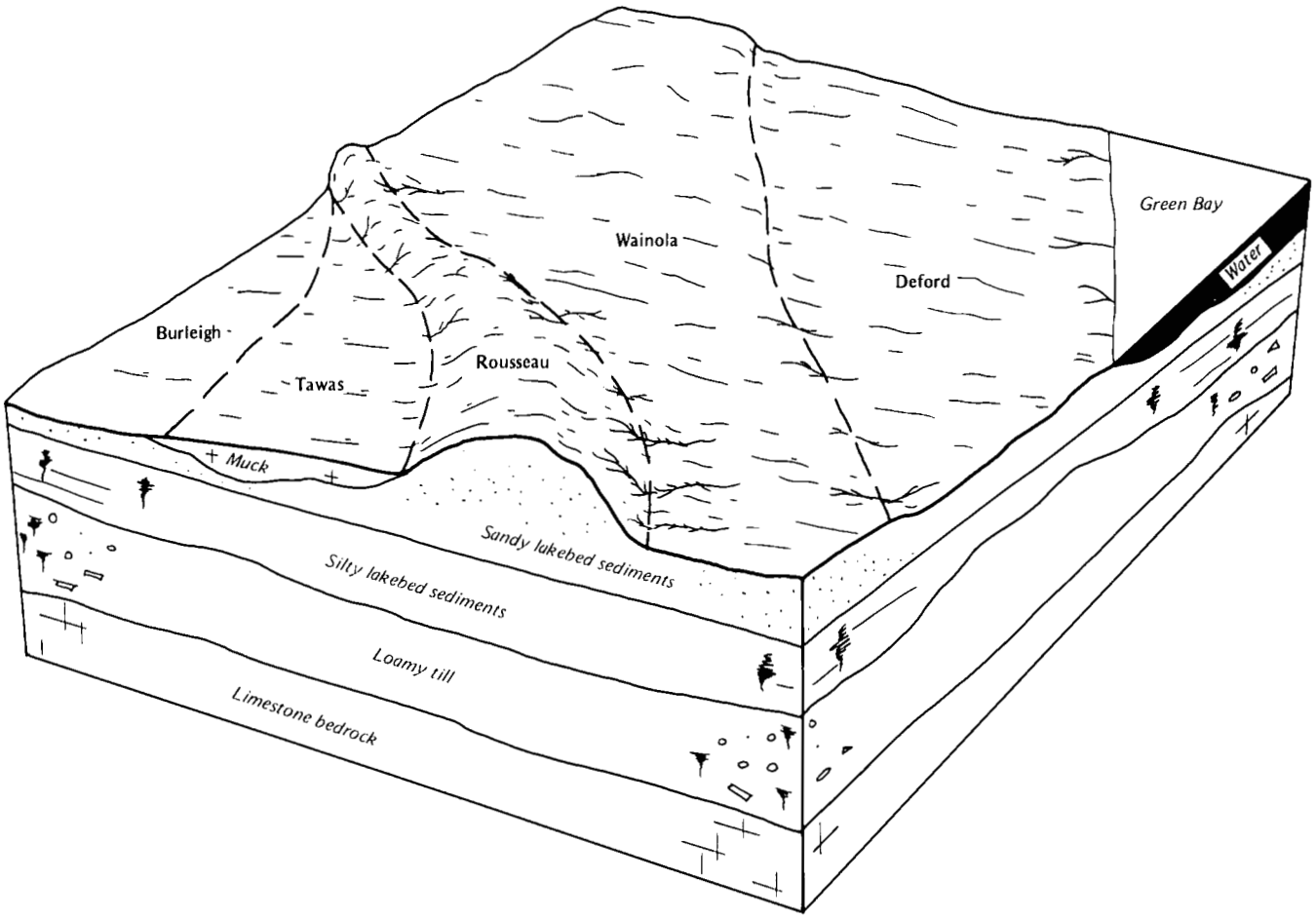

Figure 1.—Typical pattern of soils and parent material in the Deford-Wainola-Rousseau map unit.

This map unit makes up about 4 percent of the county. It is about 32 percent Solona soils, 18 percent Pickford soils, 10 percent Cathro soils, and 40 percent minor soils.

The Solona soils are on broad flats and are somewhat poorly drained. Typically, the surface layer is black loam about 2 inches thick. The subsoil is about 22 inches thick. It is friable. In sequence downward, it is mixed brown and black loam; brown loam; yellowish red, mottled loam; and brown, mottled gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam.

The Pickford soils are in depressions and drainageways and are poorly drained. Typically, the surface layer is about 3 inches of dark reddish brown mucky peat and black muck. The subsoil is mottled, firm silty clay loam about 21 inches thick. The upper part is dark gray and brown, and the lower part is reddish brown. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay loam.

The Cathro soils are in depressions and drainageways and are very poorly drained. Typically, the upper 22 inches is black muck. The subsurface layer is very dark gray fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is very dark gray, grayish brown, and light yellowish brown, mottled sandy loam.

Minor in this map unit are the Nadeau, Onaway, Posen, Johnswood, Ingalls, Wainola, Burleigh, Deford, and Ensley soils. The well drained Nadeau, Onaway, and Posen soils and the moderately well drained Johnswood soils are on uplands. The somewhat poorly drained Ingalls and Wainola soils are on the lower flats. Ingalls soils are rapidly permeable in the upper part and moderately slowly permeable in the lower part. Wainola soils are rapidly permeable throughout. The poorly drained Burleigh, Deford, and Ensley soils are in depressions and drainageways. They are coarser textured than the major soils.

This map unit is used mainly as woodland or wildlife habitat. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are concerns in managing woodland. Crops generally are not grown on this map unit because of the wetness and a scarcity of drainage outlets.

3. Onaway-Lupton

Deep, nearly level to steep, well drained and very poorly drained, loamy and mucky soils on drumlins and till plains

This map unit consists of soils in broad upland areas, on ridges, and in depressions. Slopes range from 0 to 35 percent.

This map unit makes up about 61 percent of the county. It is about 48 percent Onaway soils, 25 percent Lupton soils, and 27 percent minor soils (fig. 2).

The Onaway soils are in broad upland areas and on ridges and are well drained. They are undulating to steep. Typically, they have about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. It is friable. The upper part is dark brown fine sandy loam, and the lower part is yellowish red loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam.

The Lupton soils are in depressions and are very poorly drained. They are nearly level. They are black muck to a depth of more than 60 inches.

Minor in this map unit are the Nadeau, Summerville, Banat, Solona, Burleigh, Ensley, Minocqua, Cathro, and Tawas soils. The well drained Nadeau soils and the well drained, shallow Summerville soils are on uplands. Nadeau soils formed in loamy material over gravelly

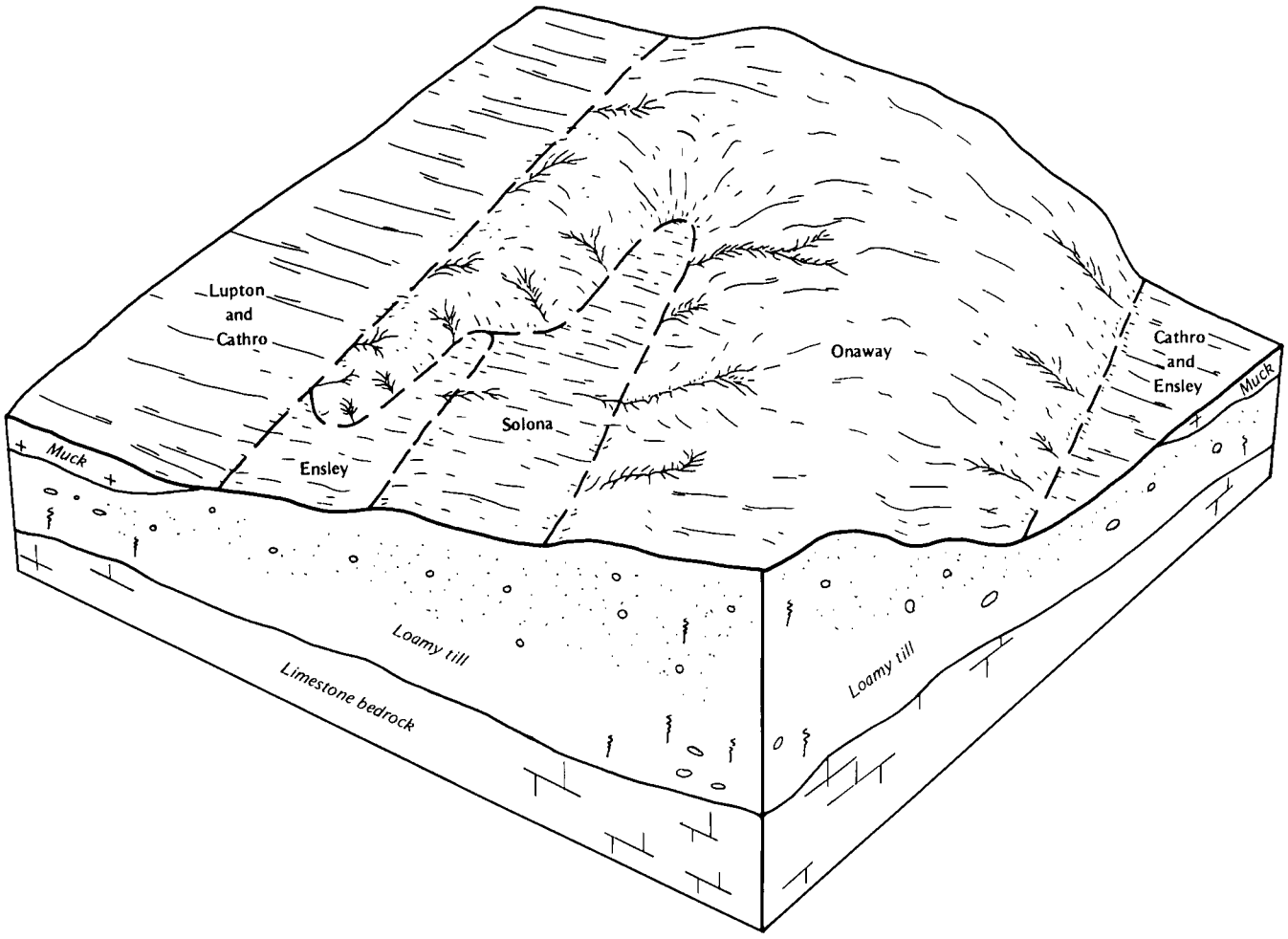

Figure 2.—Typical pattern of soils and parent material in the Onaway-Lupton map unit.

material. The somewhat poorly drained Banat and Solona soils are on the lower flats. The poorly drained Burleigh, Ensley, and Minocqua soils are in depressions and drainageways. They are dominantly mineral. The very poorly drained Cathro and Tawas soils are in depressions. Cathro soils formed in organic material over loamy material, and Tawas soils formed in organic material over sandy material.

This map unit is used mainly as woodland or cropland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are concerns in managing woodland. Water erosion is a concern in managing the rolling to steep Onaway soils as woodland or cropland. Crops generally are not grown on the Lupton soils because of the wetness and a scarcity of drainage outlets.

4. Onaway-Nadeau-Lupton

Deep, nearly level to steep, well drained and very poorly drained, loamy and mucky soils on drumlins and outwash plains

This map unit consists of soils in broad upland areas, on ridges, and in depressions. Slopes range from 0 to 35 percent.

This map unit makes up about 2 percent of the county. It is about 28 percent Onaway soils, 24 percent Nadeau soils, 18 percent Lupton soils, and 30 percent minor soils.

The Onaway soils are in broad upland areas and on ridges and are well drained. They are undulating to steep. Typically, they have about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. It is friable. The upper part is dark brown fine sandy loam, and the lower part is yellowish red loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam.

The Nadeau soils are in broad upland areas and on ridges and are well drained. They are undulating to steep. Typically, they have about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable fine sandy loam; the next part is reddish brown, friable very gravelly sandy loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand.

The Lupton soils are in depressions and are very poorly drained. They are nearly level. They are black muck to a depth of more than 60 inches.

Minor in this map unit are the Mancelona, Rousseau, Banat, Gladwin, Solona, Deford, Ensley, and Minocqua soils. The somewhat excessively drained, sandy Mancelona soils and the well drained, sandy Rousseau soils are on uplands. The somewhat poorly drained Banat, Gladwin, and Solona soils are on the lower flats. The poorly drained Deford, Ensley, and Minocqua soils are in depressions and drainageways. They are dominantly mineral.

This map unit is used mainly as woodland or cropland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are concerns in managing woodland. Also, water erosion is a hazard on the rolling to steep Onaway and Nadeau soils. The main concerns in managing cropland are controlling erosion on the Nadeau and Onaway soils and conserving moisture in the Nadeau soils during dry periods. Crops generally are not grown on the Lupton soils because of the wetness and a scarcity of drainage outlets.

5. Pemene-Grayling-Lupton

Deep, nearly level to steep, well drained, excessively drained, and very poorly drained, loamy, sandy, and mucky soils on moraines and outwash plains

This map unit consists of soils on upland plains, on ridges, and in depressions. Slopes ranges from 0 to 35 percent.

This map unit makes up about 7 percent of the county. It is about 50 percent Pemene soils, 15 percent Grayling soils, 15 percent Lupton soils, and 20 percent minor soils (fig. 3).

The Pemene soils are on upland plains and ridges and are well drained. They are undulating to steep. Typically, they have about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is about 2 inches of black loamy fine sand or fine sandy loam. The subsurface layer is brown loamy fine sand about 13 inches thick. The next 6 inches is mixed brown loamy fine sand and reddish brown fine sandy loam. The subsoil is about 16 inches thick. It is friable. The upper part is reddish brown fine sandy loam, and the lower part is yellowish red loamy sand. The substratum to a depth of about 60 inches is loamy sand. It is light reddish brown in the upper part and reddish yellow in the lower part.

The Grayling soils are on upland plains and ridges and are excessively drained. They are undulating and gently rolling. Typically, the surface layer is black sand about 4 inches thick. The subsoil is strong brown sand about 26 inches thick. The upper part is very friable, and the lower part is loose. The substratum to a depth of about 60 inches is reddish yellow sand.

The Lupton soils are in depressions and are very poorly drained. They are nearly level. They are black muck to a depth of more than 60 inches.

Minor in this map unit are the Rubicon, Nadeau, Onaway, Rousseau, Banat, Solona, Arnheim, Deford, Ensley, Minocqua, and Tawas soils. The excessively drained Rubicon soils and the well drained Nadeau, Onaway, and Rousseau soils are on uplands. The somewhat poorly drained Banat and Solona soils are on

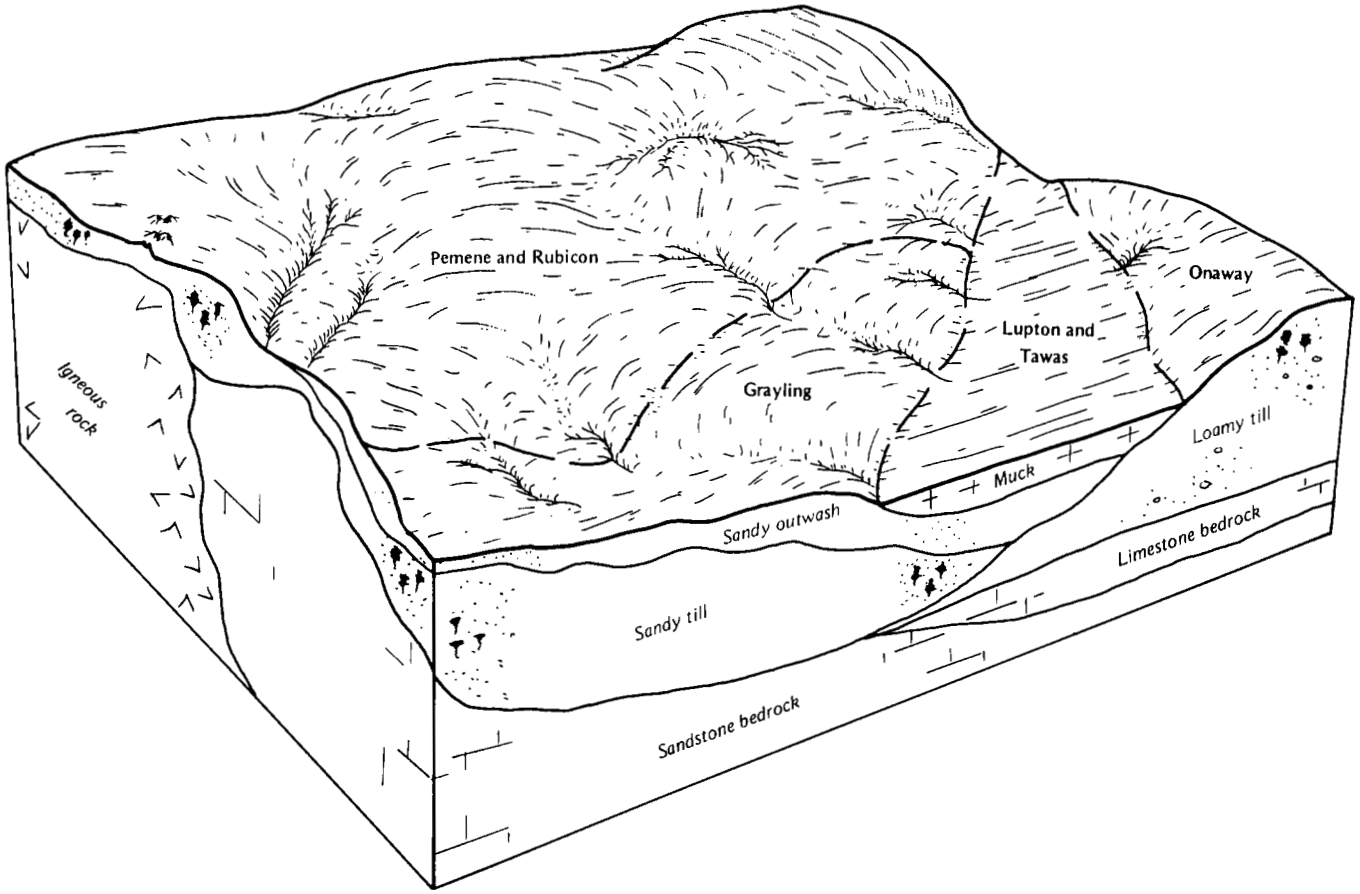

Figure 3.—Typical pattern of soils and parent material in the Pemene-Grayling-Lupton map unit.

the lower flats. The poorly drained Arnheim, Deford, Ensley, and Minocqua soils are in depressions, in drainageways, and on flood plains. The very poorly drained Tawas soils are in depressions. They formed in organic material over sandy material.

This map unit is used mainly as woodland or cropland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are concerns in managing woodland. Also, water erosion is a hazard on the rolling to steep Pemene soils. Water erosion and soil blowing are concerns in managing the Pemene soils as cropland. Crops generally are not grown on the Grayling and Lupton soils. The Grayling soils are droughty and are susceptible to soil blowing. The Lupton soils have a seasonal high water table and cannot be easily drained because drainage outlets are not readily available.

6. Onaway-Lupton-Rousseau

Deep, nearly level to steep, well drained, moderately well drained, and very poorly drained, loamy, mucky, and sandy soils on drumlins, till plains, and outwash plains

This map unit consists of soils on upland plains, on ridges, and in depressions. Slopes range from 0 to 35 percent.

This map unit makes up about 8 percent of the county. It is about 25 percent Onaway soils, 20 percent Lupton soils, 15 percent Rousseau soils, and 40 percent minor soils.

The Onaway soils are on upland plains and ridges and are well drained. They are nearly level to steep. Typically, they have about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. It is friable. The upper part is dark brown fine sandy loam, and the lower part is yellowish red loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam.

The Lupton soils are in depressions and are very poorly drained. They are nearly level. They are black muck to a depth of more than 60 inches.

The Rousseau soils are on upland plains and ridges and are well drained and moderately well drained. They are nearly level to hilly. Typically, they have about 1 inch of black, decomposed forest litter at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand.

Minor in this map unit are the Nadeau, Solona, Wainola, Rousseau, Arnheim, Burleigh, Deford, and Ensley soils. The well drained Nadeau soils are on ridges and knolls. Nadeau soils are moderately permeable in the upper part and very rapidly permeable in the lower part. The somewhat poorly drained Solona and Wainola soils and the moderately well drained Rousseau soils are in slight depressions. The poorly drained Arnheim, Burleigh, Deford, and Ensley soils are in depressions and drainageways and on flood plains.

This map unit is used mainly as woodland or cropland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are concerns in managing woodland. Also, water erosion is a hazard on the rolling to steep Onaway soils. The main concerns in managing cropland are erosion on the Onaway soils and soil blowing and droughtiness on the Rousseau soils. Crops generally are not grown on the Lupton soils because of the wetness and a scarcity of drainage outlets.

7. Onaway-Summerville-Lupton

Deep and shallow, nearly level to steep, well drained and very poorly drained, loamy and mucky soils on drumlins and till plains

This map unit consists of soils on upland plains, on ridges, and in depressions. Slopes range from 0 to 35 percent.

This map unit makes up about 7 percent of the county. It is about 25 percent Onaway soils, 20 percent Summerville soils, 15 percent Lupton soils and 40 percent minor soils (fig. 4).

The Onaway soils are on upland plains and ridges. They are deep, well drained, and undulating to steep.

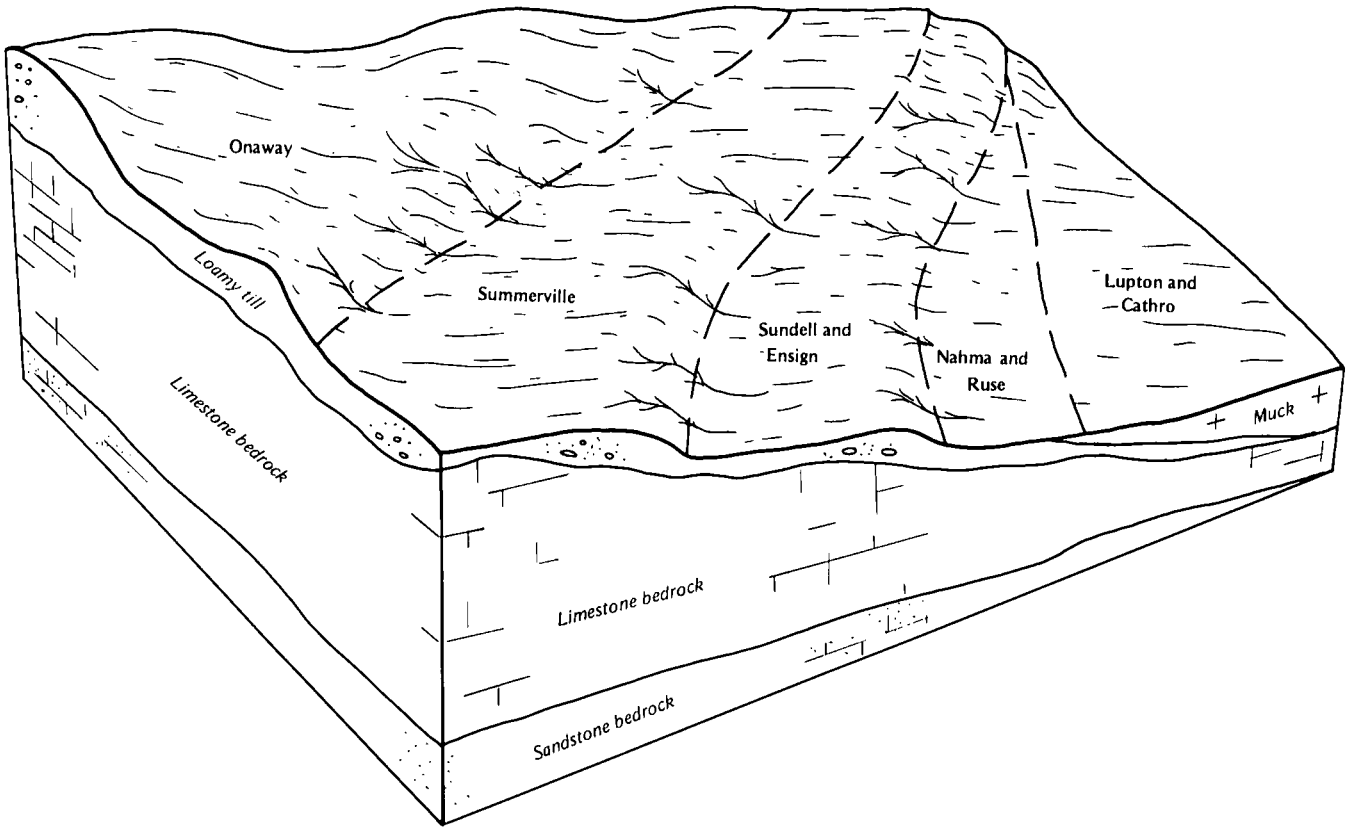

Figure 4.—Typical pattern of soils and parent material in the Onaway-Summerville-Lupton map unit.

Typically, they have about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. It is friable. The upper part is dark brown fine sandy loam, and the lower part is yellowish red loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam.

The Summerville soils are on upland plains. They are shallow, well drained, and nearly level and undulating. Typically, the surface layer is very dark grayish brown fine sandy loam about 2 inches thick. The subsoil is friable fine sandy loam about 14 inches thick. The upper part is brown, and the lower part is dark brown. Limestone bedrock is at a depth of about 16 inches.

The Lupton soils are in depressions. They are deep, very poorly drained, and nearly level. They are black muck to a depth of more than 60 inches.

Minor in this map unit are the Nadeau, Cunard, Ensign, Solona, Sundell, Ensley, Nahma, Ruse, and Cathro soils. The well drained Nadeau soils and the well drained, moderately deep Cunard soils are on upland ridges. Nadeau soils formed in loamy material over gravelly material. The somewhat poorly drained Ensign, Solona, and Sundell soils are in slight depressions. The poorly drained Ensley, Nahma, and Ruse soils are in depressions and drainageways. The very poorly drained Cathro soils are in depressions. They formed in organic material over loamy material.

This map unit is used mainly as woodland or cropland. The windthrow hazard, seedling mortality, the equipment limitation, and plant competition are concerns in managing woodland. Also, water erosion is a concern on the rolling to steep Onaway soils. The main concern in managing cropland is erosion on the Onaway soils. Crops are generally not grown on the Lupton and Summerville soils. The Lupton soils have a seasonal high water table and cannot be easily drained because of a scarcity of drainage outlets. The Summerville soils are shallow over bedrock.

8. Lupton-Loxley

Deep, nearly level, very poorly drained, mucky and peaty soils on lake plains

This map unit consists of soils in depressions and bogs. Slopes are generally less than 2 percent.

This map unit makes up about 2 percent of the county. It is about 42 percent Lupton soils, 38 percent Loxley soils, and 20 percent minor soils.

The Lupton soils are in depressions. They are black muck to a depth of more than 60 inches.

The Loxley soils are in bogs. They are extremely acid. The surface layer is light yellowish brown peat about 8 inches thick. The subsurface layer is about 8 inches of dark reddish brown muck and mucky peat. Below this to a depth of about 60 inches is dark reddish brown muck.

Minor in this map unit are the well drained Nadeau, Onaway, and Rousseau soils on upland plains and ridges and the poorly drained Deford and Ensley soils in areas adjacent to the uplands.

This map unit is used mainly as woodland or wildlife habitat. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are concerns in managing woodland.

Broad Land Use Considerations

The general soil map is helpful in identifying broad areas that can be developed for residential, industrial, agricultural, and other uses. It cannot be used, however, in the selection of sites for specific structures or specific crops. The paragraphs that follow describe the major land uses in the county.

Cropland

About 19 percent of the county is cropland, which is used mainly for alfalfa, small grain, and corn (*14*). Most of the cropland is in map units 3, 4, 6, and 7, in the central and northeastern parts of the county.

The very poorly drained, organic soils in these units generally are not cultivated because of excess water, a scarcity of adequate drainage outlets, and the hazards of soil blowing and subsidence after a drainage system is installed. Also, operating farm equipment on these soils is difficult. If future economic conditions are favorable, it may be feasible to clear and drain these soils and use them for vegetables or other specialty crops.

Generally, the well drained soils on uplands in units 3, 4, 6, and 7 are fairly well suited to cropland. Erosion-control measures may be needed in the steeper areas. The Nadeau soils in unit 4 are underlain by sand and gravel outwash. They have a high content of stones and cobbles and may be droughty during dry periods. The Rousseau soils in unit 6 are sandy. If these sandy soils are cultivated, soil blowing and droughtiness during dry periods are problems. The Summerville soils in unit 7 are shallow over limestone bedrock. These soils tend to be stony and droughty. Generally, the soils that are steep, droughty, or shallow over bedrock are better suited to woodland, pasture, or permanent hayland.

Woodland

About 75 percent of Menominee County is wooded (*14*). The soils in most of the map units are productive woodland sites. The major soils in unit 8, however, are organic soils that generally are not productive when used as woodland. Most of the upland soils in units 3, 4, 5, 6, and 7 support northern hardwoods, but aspen and aspen-birch stands are common on severely burned sites. The very poorly drained, organic soils in these units and in unit 8 support mixed stands of northern white-cedar, balsam fir, tamarack, and black spruce.

Units 1 and 2 dominantly support lowland hardwoods and conifers.

Because of wetness, the slope, or a sandy surface layer, the equipment limitation is the main concern in managing the woodland in Menominee County. Plant competition, seedling mortality, and windthrow also are concerns on some soils.

Urban Development

About 6 percent of Menominee County is urban or built-up land (*14*). The poorly drained and very poorly drained soils are generally unsuited to urban development because of ponding or wetness. The soils in the upland areas of units 3, 4, 5, 6, and 7 generally are suited to urban development. The sandy soils in units 5 and 6, however, have a poor filtering capacity if they are used as sites for septic tank absorption fields. Also, the depth to bedrock is a severe limitation if the shallow soils in unit 7 are used as sites for sanitary facilities or buildings.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Onaway fine sandy loam, 3 to 9 percent slopes, is a phase of the Onaway series.

Some map units are made up of two or more major soils. These map units are called soil complexes or soil associations.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Onaway-Rousseau complex, 3 to 12 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. The Lupton-Cathro association is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions, names, and delineations of the soils on the detailed maps of this survey area do not fully agree or match with those of the soils on older maps of adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in concepts of soil series, and variations in the intensity of mapping or in the extent of the soils in the survey areas.

Table 7 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

10B—Onaway fine sandy loam, 3 to 9 percent slopes. This deep, undulating and gently rolling, well drained soil is on ridges and knolls in the uplands. Individual areas are linear or irregularly shaped and range from 5 to more than 500 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 or more than 30 inches. In some areas the lower part of the subsoil has less clay.

Included with this soil in mapping are small areas of the poorly drained Ensley and somewhat poorly drained Solona soils in drainageways and depressions. Also included are small areas of the well drained Nadeau and Cunard soils, which are in landscape positions similar to those of the Onaway soil. Nadeau soils have more sand and gravel in the substratum than the Onaway soil. Cunard soils have limestone bedrock at a depth of 20 to 40 inches. Included soils make up 10 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Onaway soil. Surface runoff is slow or medium.

Most areas of this soil are used as woodland (fig. 5) or cropland. A few are used as pasture. The major concern in managing woodland is plant competition. The equipment limitation is moderate on landing sites. In other areas the use of equipment may be briefly limited in spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. The best sites for landings are the nearly level included areas. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion and maintain the organic matter content. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system

Figure 5.—Second growth stand of sugar maple, white ash, and basswood in an area of Onaway fine sandy loam, 3 to 9 percent slopes.

of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing can cause surface compaction and excessive runoff and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbol is 3A, the land capability classification is IIIe, and the Michigan soil management group is 3a. The primary habitat type is AVO, and the secondary habitat type is TM.

10D—Onaway fine sandy loam, 12 to 35 percent slopes. This deep, rolling to steep, well drained soil is on ridges and hills in the uplands. Individual areas are irregularly shaped and range from 5 to 160 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 inches. In some areas the lower part of the subsoil has less clay.

Included with this soil in mapping are small areas of the poorly drained Ensley and somewhat poorly drained Solona soils on foot slopes. Also included are small areas of the well drained Nadeau soils. These soils are in landscape positions similar to those of the Onaway soil. They have more sand and gravel in the substratum than the Onaway soil. Included soils make up about 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Onaway soil. Surface runoff is rapid.

Most areas of this soil are used as woodland. A few areas are used as cropland or pasture.

The major concerns in managing woodland are the equipment limitation, the erosion hazard, and plant competition. The slope limits the use of equipment and the number of suitable landing sites. Special care is needed in laying out logging roads and in operating equipment. The roads should be designed so that they conform to the topography and should be built on the contour as much as possible. The use of equipment may be briefly limited in spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. Erosion can be minimized by locating logging roads and skid trails on gentle grades; by removing water with water bars, out-sloping road surfaces, and culverts; and by seeding skid roads and trails after logging activities are completed. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

Crops generally are not grown on this soil because of the slope and a severe hazard of erosion. Overcoming these limitations generally is not practical.

This soil is poorly suited to pasture. The main concern in managing pastured areas is the erosion hazard. Measures that prevent overgrazing help to maintain an adequate plant cover and thus help to control runoff and erosion.

The woodland ordination symbol is 3R, the land capability classification is VIe, and the Michigan soil management group is 3a. The primary habitat type is AVO, and the secondary habitat type is TM.

11B—Posen cobbly fine sandy loam, 3 to 12 percent slopes, very stony. This deep, undulating and gently rolling, well drained soil is on broad ridges and knolls in the uplands. Flat stones are on the surface. They are 15 to 25 inches long and are 1 to 3 feet apart. Individual areas are irregularly shaped and range from 5 to 90 acres in size.

Typically, the surface layer is dark brown cobbly fine sandy loam about 4 inches thick. The subsurface layer is brown gravelly fine sandy loam about 4 inches thick. The subsoil is about 14 inches thick. The upper part is reddish brown, friable very gravelly loam; the next part is strong brown, friable very gravelly fine sandy loam; and the lower part is brown, very friable extremely gravelly sandy loam. The substratum to a depth of about 60 inches is brown very gravelly sandy loam. In places limestone bedrock is at a depth of 20 to 60 inches.

Included with this soil in mapping are small areas of the poorly drained Ensley and somewhat poorly drained Solona soils in depressions and drainageways and on foot slopes. Also included are small areas of the well drained Nadeau soils. These soils are in landscape positions similar to those of the Posen soil. They have a very low available water capacity. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderate in the Posen soil, and the available water capacity is low. Surface runoff is slow or medium.

Most areas of this soil are used as woodland. A few are used as cropland or pasture.

The major concerns in managing woodland are the equipment limitation, plant competition, and the windthrow hazard. The large stones on the surface may reduce the operating speed of skidders. Also, the use of equipment may be briefly limited in spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. The best sites for landings are the small included areas of nearly level, well drained soils. When openings are made in the canopy, invading plants can prevent or delay reforestation. Plant competition can be controlled by mechanical or chemical means. Because of the high content of pebbles, cobbles, and stones, the trees on this soil are shallow rooted. Some may be blown down

by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees.

This soil generally is not used for crops or pasture because of the high content of pebbles, cobbles, and stones.

The woodland ordination symbol is 3X, the land capability classification is VIs, and the Michigan soil management group is Ga. The primary habitat type is TM, and the secondary habitat type is AVO.

12B—Nadeau fine sandy loam, 3 to 12 percent slopes. This deep, undulating and gently rolling, well drained soil is on stream terraces and on flats, ridges, and knolls in the uplands. Individual areas are irregularly shaped and range from 5 to 200 acres in size.

Typically, about 2 inches of black, partially decomposed forest litter is at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable fine sandy loam, the next part is reddish brown, friable very gravelly sandy loam, and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand. In places the upper part of the soil is sand or loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Banat and poorly drained Minocqua soils in depressions and drainageways. Also included are small areas of the well drained Onaway soils. These soils are in landscape positions similar to those of the Nadeau soil. They have a moderate available water capacity. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderate in the loamy upper part of the Nadeau soil and very rapid in the sandy lower part. The available water capacity is very low. Surface runoff is slow or medium.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. The major concerns in managing woodland are the windthrow hazard and plant competition. The equipment limitation is moderate on landing sites. The best sites for landings are the small nearly level included areas. Because of the high content of pebbles and cobbles, the trees on this soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

This soil is poorly suited to crops, but such crops as oats, barley, and a mixture of grasses and legumes can be grown. The main management needs are measures that control erosion, maintain the organic matter content, and conserve moisture during dry periods. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. In some areas pebbles and cobbles on the surface hinder seedbed preparation and harvesting. They can be removed by a rock picker and can be buried or stockpiled.

This soil is fairly well suited to pasture. The main concern in managing pastured areas is conserving moisture during dry periods, when the amount of soil moisture is insufficient for optimum plant growth. Rotation grazing or strip grazing and restricted use during dry periods help to maintain forage production.

The woodland ordination symbol is 2S, the land capability classification is IVe, and the Michigan soil management group is 3/5a. The primary habitat type is TM, and the secondary habitat type is AVO.

12D—Nadeau fine sandy loam, 15 to 35 percent slopes. This deep, rolling to steep, well drained soil is on ridges and hills in the uplands. Individual areas are linear or irregularly shaped and range from 5 to 200 acres in size.

Typically, about 2 inches of black, partially decomposed forest litter is at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable fine sandy loam; the next part is reddish brown, friable very gravelly sandy loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand. In places the upper part of the soil is sand or loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Banat and poorly drained Minocqua soils on foot slopes. Also included are small areas of the well drained Onaway soils. These soils are in landscape positions similar to those of the Nadeau soil. They have a moderate available water capacity. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the loamy upper part of the Nadeau soil and very rapid in the sandy lower part. The available water capacity is very low. Surface runoff is medium.

Most areas of this soil are used as woodland. The equipment limitation, the erosion hazard, the windthrow hazard, and plant competition are management concerns. The slope limits the use of equipment and the number of suitable landing sites. Special care is needed in laying out logging roads and in operating equipment. The roads should be designed so that they conform to the topography and should be built on the contour as much as possible. Erosion can be minimized by locating logging roads and skid trails on gentle grades; by removing water with water bars, out-sloping road surfaces, and culverts; and by seeding skid roads and trails after logging activities are complete.

Because of the high content of pebbles and cobbles, the trees on this soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

Crops generally are not grown on this soil because of the slope and droughtiness. Overcoming these limitations generally is not practical.

This soil is poorly suited to pasture. The main concerns in managing pastured areas are controlling erosion and conserving moisture during dry periods. Rotation grazing or strip grazing helps to keep the pasture in good condition.

The woodland ordination symbol is 2R, the land capability classification is VIIe, and the Michigan soil management group is 3/5a. The primary habitat type is TM.

14—Minocqua-Tawas complex. These deep, nearly level soils are in broad low areas, in depressions, and in drainageways. They are frequently ponded. The Minocqua soil is poorly drained, and the Tawas soil is very poorly drained. Individual areas are irregularly shaped or elongated and range from 5 to 200 acres in size. They are 40 to 65 percent Minocqua soil and 20 to 50 percent Tawas soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the upper 7 inches of the Minocqua soil is black muck and black mucky silt loam. The subsoil is about 15 inches thick. It is mottled and friable. The upper part is dark grayish brown loam, the next part is dark yellowish brown fine sandy loam, and the lower part is yellowish brown gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, stratified sand and very gravelly sand. In some areas it is loamy. In places the upper part of the subsoil is sand or loamy sand.

Typically, the upper 4 inches of the Tawas soil is black mucky peat. The subsurface layer is black muck about 21 inches thick. The upper part of the substratum is black mucky fine sand. The lower part to a depth of about 60 inches is dark grayish brown sand. In some areas the muck is more than 51 inches thick. In other areas the substratum is loamy.

Included with these soils in mapping are small areas of Banat, Gladwin, and Nadeau soils. Banat and Gladwin soils are somewhat poorly drained and are in the slightly higher landscape positions. Nadeau soils are well drained and are on ridges and knolls. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the upper part of the Minocqua soil and rapid or very rapid in the lower part. It is moderately slow to moderately rapid in the organic part of the Tawas soil and rapid in the mineral part. The available water capacity is low in the Minocqua soil and high in the Tawas soil. Surface runoff is very slow or ponded on both soils. The seasonal high water table is near or above the surface from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Some areas are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Equipment should be used only when the ground is frozen. On sites for year-round roads, fill, gravel, and culverts are needed.

Because of the wetness, the trees on these soils are shallow rooted and seedling mortality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops generally are not grown on these soils because of the high water table and the hazard of frost. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 7W and 5W, the land capability classification is VIw, and the Michigan soil management groups are 3/5c and M/4c. The primary habitat type is TTM, and the secondary habitat type is FMC.

15A—Gladwin loamy sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low, broad flats and in depressions and drainageways on uplands. Individual areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, about 3 inches of black, well decomposed forest litter is at the surface. The surface layer is light brownish gray loamy sand about 3 inches thick. The subsoil is mottled loamy sand about 29 inches thick. The upper part is reddish brown and dark brown and is very friable, the next part is strong brown and very friable, and the lower part is dark yellowish brown and loose. The substratum to a depth of about 60 inches is light yellowish brown sand. In places the subsoil has no clay bridges between sand grains. In some areas the content of pebbles and cobbles is more than 35 percent in the subsoil.

Included with this soil in mapping are small areas of the somewhat excessively drained Mancelona and well drained Nadeau soils on ridges and knolls. Also included are small areas of the poorly drained Minocqua soils in

depressions. Included soils make up as much as 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Gladwin soil and rapid or very rapid in the lower part. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. The major concerns in managing woodland are the equipment limitation, the windthrow hazard, and plant competition. Equipment should be used only when the ground is frozen. On sites for logging roads, fill, gravel, and culverts are needed. The best landing sites are the small areas of included Mancelona and Nadeau soils, which are better drained than the Gladwin soil.

Because of the seasonal wetness, the trees on these soils are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management concerns are controlling soil blowing, maintaining the organic matter content, conserving moisture during dry periods, and removing excess water during wet periods. Cover crops, buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface help to control soil blowing. Conservation tillage and additions of organic matter increase the available water capacity. A combination of surface and subsurface drains can lower the seasonal high water table, but locating drainage outlets may be difficult.

This soil is well suited to pasture. The main management concern is conserving moisture during dry periods. Proper stocking rates, rotation grazing, and restricted use during dry periods and during extremely wet periods help to keep the pasture in good condition.

The woodland ordination symbol is 4W, the land capability classification is IIIw, and the Michigan soil management group is 5b. The primary habitat type is TMC.

16—Ensley mucky silt loam. This deep, nearly level, poorly drained soil is in depressions, on broad, low flats, and in drainageways on uplands. It is frequently ponded. Individual areas are irregularly shaped or elongated and range from 5 to 200 acres in size.

Typically, the surface layer is about 6 inches of black muck and mucky silt loam. The subsoil is about 12 inches thick. It is mottled. The upper part is very dark grayish brown, very friable loam, and the lower part is yellowish brown, friable fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled gravelly fine sandy loam. In places it is very gravelly sand or stratified fine sand and very fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Burleigh soils. These soils are in landscape positions similar to those of the Ensley soil. They have a moderate available water capacity. Also included are areas of the very poorly drained Cathro soils in the slightly lower landscape positions and the somewhat poorly drained Solona soils on slight rises. Included soils make up about 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of the Ensley soil and moderately rapid in the lower part. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Most areas of this soil are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. If wheeled skidders are used when the soil is wet, logging roads tend to be slippery and ruts form quickly. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the soil is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed.

Because of the seasonal wetness, the trees on this soil are shallow rooted and seedling mortality may exceed 50 percent. Some trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

Crops are generally not grown on this soil because of the high water table and the scarcity of drainage outlets. Overcoming the limitations that affect crops generally is not practical.

This soil is poorly suited to pasture, mainly because of the excess water. Overgrazing or grazing when the soil is too wet can cause compaction and can destroy forage plants. Proper stocking rates, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbol is 3W, the land capability classification is Vw, and the Michigan soil management group is 3c. The primary habitat type is FMC.

17—Cathro-Ensley complex. These deep, nearly level soils are in depressions, on low flats, and in drainageways on uplands. They are frequently ponded. The Cathro soil is very poorly drained, and the Ensley soil is poorly drained. Individual areas are irregularly shaped and range from 10 to more than 200 acres in size. They are 40 to 65 percent Cathro soil and 20 to 40 percent Ensley soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the upper 22 inches of the Cathro soil is black muck. The surface layer is very dark gray fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is very dark gray, grayish brown, and light yellowish brown, mottled sandy loam. In some areas it is sand or loamy sand. In some places the organic material is more than 51 inches thick. In other places it has a thin layer of marl.

Typically, the Ensley soil has a surface layer of black muck and mucky silt loam about 6 inches thick. The subsoil is about 12 inches thick. It is mottled. The upper part is dark grayish brown, very friable loam, and the lower part is yellowish brown, friable fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled gravelly fine sandy loam. In places it is very gravelly sand or stratified fine sand and very fine sandy loam.

Included with these soils in mapping are small areas of Deford, Onaway, and Solona soils. Deford soils are dominantly sandy. They are in landscape positions similar to those of the Cathro and Ensley soils. Onaway soils are well drained and are on ridges and knolls. Solona soils are somewhat poorly drained and are in the slightly higher landscape positions. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic part of the Cathro soil and moderate or moderately slow in the mineral part. It is moderate in the upper part of the Ensley soil and moderately rapid in the lower part. The available water capacity is high in both soils. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Many areas are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Equipment should be used only when the ground is frozen. On sites for year-round roads, fill, gravel, and culverts are needed.

Because of the wetness, the trees on these soils are shallow rooted and seedling mortality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops generally are not grown on these soils because of the high water table and the scarcity of drainage outlets. The soils are poorly suited to pasture, mainly because of the excess water and the instability of the organic material. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 5W and 3W, the land capability classification is VIw, and the Michigan soil management groups are M/3c and 3c. The primary habitat type is TTM, and the secondary habitat type is FMC.

18—Lupton-Cathro association. These deep, very poorly drained, nearly level soils are in depressions, on low flats, and in drainageways on uplands. They are frequently ponded. Generally, the Lupton soil is near the middle of the mapped areas and the Cathro soil is near the edges. Individual areas are linear or irregularly shaped and range from 5 to more than 600 acres in size. They are about 50 to 70 percent Lupton soil and 20 to 40 percent Cathro soil.

Typically, the Lupton soil is black muck to a depth of more than 60 inches. In some areas it has marl or more than 10 inches of mucky peat within 51 inches of the surface.

Typically, the upper 22 inches of the Cathro soil is black muck. The subsurface layer is very dark gray fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is very dark gray, grayish brown, and light yellowish brown, mottled sandy loam. In some areas it is sand or loamy sand. In other areas the muck is less than 16 inches thick.

Included with these soils in mapping are small areas of the poorly drained Ensley soils. These soils are at the edges of the mapped areas. Also included are small areas of the well drained Onaway and Nadeau soils on ridges and knolls. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow to moderately rapid in the Lupton soil. It is moderately slow to moderately rapid in the upper part of the Cathro soil and moderate or moderately slow in the lower part. The available water capacity is high in both soils. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall to summer.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. The soils generally are not suitable for the use of ordinary crawler

tractors or rubber-tired skidders. Special harvesting equipment may be needed. Access to these soils is easiest during periods in winter when access roads are frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed.

Because of the wetness, the trees on these soils are shallow rooted and seedling morality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops are generally not grown on these soils because of the frost hazard, the instability of the organic material, and the wetness. The soils are poorly suited to pasture, mainly because of the excess wetness and the instability. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 2W and 5W, the land capability classification is Vw and Vlw, and the Michigan soil management groups are Mc and M/3c. The primary habitat type is TTM, and the secondary habitat type is TTS.

19—Loxley-Dawson association. These deep, very poorly drained, nearly level soils are in bogs. They are frequently ponded. Generally, the Loxley soil is near the middle of the bogs and the Dawson soil is near the edges. Individual areas are irregularly shaped or circular and range from 5 to more than 200 acres in size. They are 50 to 70 percent Loxley soil and 20 to 30 percent Dawson soil.

Typically, the Loxley soil has a surface layer of light yellowish brown peat about 8 inches thick. The subsurface layer is about 8 inches of dark reddish brown muck and mucky peat. The bottom tier to a depth of about 60 inches is dark reddish brown muck. In places the pH is more than 4.5. In some areas the subsurface layer and bottom tier have more than 10 inches of mucky peat.

Typically, the Dawson soil has a surface layer of light yellowish brown peat about 6 inches thick. Below this is dark reddish brown and black muck about 16 inches thick. The upper part of the substratum is very dark gray mucky fine sand about 3 inches thick. The lower part to a depth of about 60 inches is dark brown fine sand. In some areas it is loamy.

Included with these soils in mapping are small areas of the poorly drained Deford soils in the slightly higher landscape positions. Also included are small areas of the well drained Rousseau soils on ridges and knolls. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow to moderately rapid in the Loxley soil. It is moderately slow to moderately rapid in the organic part of the Dawson soil and rapid in the mineral part. The available water capacity is high in both soils. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring. The organic material in both soils is extremely acid.

Most areas support native bog vegetation. Black spruce and tamarack are the most common tree species. Labrador tea, bog rosemary, and leatherleaf are the most common shrubs. These soils generally are unsuited to woodland, cropland, and pasture because of the extreme acidity, the instability of the organic material, and the wetness. Overcoming these limitations is not practical.

The woodland ordination symbol is 2W, the land capability classification is VIIw, and the Michigan soil management groups are Mc and M/4c. The primary habitat type is PCS.

20A—Solona loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad flats, in depressions, and in drainageways on uplands. Individual areas are irregularly shaped or linear and range from 5 to 265 acres in size.

Typically, the surface layer is black loam about 2 inches thick. The subsoil is about 22 inches thick. The upper part is brown and black, friable loam; the next part is yellowish red, mottled, friable loam; and the lower part is brown, mottled, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam. In places it is very gravelly coarse sand.

Included with this soil in mapping are small areas of the poorly drained Ensley soils in the lower landscape positions. Also included are small areas of the well drained Onaway soils on ridges and knolls. Included soils make up about 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Solona soil. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. The main concerns in managing woodland are the equipment limitation, the windthrow hazard, and plant competition. The main limitation is the seasonal wetness. If wheeled skidders are used when the soil is wet, logging roads tend to be slippery and ruts form quickly. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for logging roads, fill, gravel, and culverts are needed. The best landing sites are the included areas of well drained Onaway soils.

Because of the seasonal wetness, the trees on this soil are shallow rooted. Some may be blown down during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

This soil is well suited to such crops as corn, oats, barley, and a mixture of grasses and legumes. The main management needs are measures that remove excess water during wet periods and that maintain good tilth. Shallow surface ditches are effective in removing excess surface water. If drainage outlets are available, a subsurface drainage system helps to lower the seasonal high water table. Unless they are protected, the tile lines can become plugged with sandy material. If worked when too wet, the soil becomes cloddy and compacted. Additions of organic material and a system of conservation tillage that does not invert the soil and that leaves crop residue on the surface help to maintain good tilth. Limiting the use of equipment during wet periods also helps to maintain good tilth.

This soil is well suited to pasture. The main management concerns are removing excess water during wet periods and preventing excessive compaction. Grazing when the soil is too wet can cause compaction and can destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition. Excess water can be removed by surface drains if drainage outlets are available.

The woodland ordination symbol is 3W, the land capability classification is IIw, and the Michigan soil management group is 3b. The primary habitat type is TM, and the secondary habitat type is TMC.

21—Deford mucky fine sand. This deep, nearly level, poorly drained soil is on broad flats and in depressions and drainageways on uplands. It is frequently ponded. Individual areas are irregularly shaped and range from 5 to more than 200 acres in size.

Typically, the surface layer is about 7 inches of black muck and mucky fine sand. The substratum to a depth of about 60 inches is fine sand. It is grayish brown and mottled in the upper part and brown and dark reddish brown in the lower part. In some areas the substratum is sand or gravelly sand. In other areas the lower part of the substratum is gravelly fine sandy loam or silt loam.

Included with this soil in mapping are small areas of the very poorly drained Tawas soils in the slightly lower landscape positions. Also included are small areas of the well drained and moderately well drained Rousseau soils and the somewhat poorly drained Wainola soils. Rousseau soils are on ridges and knolls, and Wainola soils are in the slightly higher landscape positions. Included soils make up 10 to 15 percent of the map unit.

Permeability is rapid in the Deford soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Most areas of this soil are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Ruts form easily if wheeled skidders are used on this soil. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best sites for log landings are the small included areas of well drained or moderately well drained Rousseau soils.

Because of the wetness, the trees on this soil are shallow rooted and seedling mortality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

Crops are generally not grown on this soil because of the high water table and the frost hazard. Overcoming these limitations generally is not practical. The soil is poorly suited to pasture, mainly because of the excess water. Open ditches can help to remove the water, but in many places adequate outlets are not readily available.

The woodland ordination symbol is 4W, the land capability classification is Vw, and the Michigan soil management group is 5c. The primary habitat type is FMC.

22A—Wainola fine sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low, broad plains and in depressions and drainageways on uplands. Individual areas are irregularly shaped and range from 5 to 400 acres in size.

Typically, about 2 inches of black, well decomposed organic material is at the surface. The surface layer is pinkish gray fine sand about 10 inches thick. The subsoil is mottled fine sand about 29 inches thick. The upper part is reddish brown and very friable, the next part is strong brown and very friable, and the lower part is brown and loose. The substratum to a depth of about 60 inches is brown very fine sand. In some areas the sand is coarser throughout the profile. In other areas the substratum is silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Solona soils. These soils are in landscape positions similar to those of the Wainola soil. They are loamy throughout. Also included are small areas of the poorly drained Deford soils and the well drained and moderately well drained Rousseau soils. Deford soils are in the lower landscape positions, and Rousseau soils are on ridges and knolls. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Wainola soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. The main concerns in managing woodland are the equipment limitation, the windthrow hazard, and plant competition. Equipment should be used only when the soil is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are the small included areas of Rousseau soils, which are better drained than the Wainola soil.

Because of the seasonal wetness, the trees on this soil are shallow rooted. Some may be blown down during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that remove excess water during wet periods, conserve moisture during dry periods, control soil blowing, and maintain the organic matter content. Cover crops, buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface help to control soil blowing. A combination of surface and subsurface drains can lower the seasonal high water table, but locating suitable drainage outlets may be difficult. Erosion-control structures may be needed where surface ditches enter the drainageways. Unless they are protected, the tile lines can become plugged with sandy material. Conservation tillage and additions of organic material increase the available water capacity.

This soil is well suited to pasture. The main management concerns are controlling soil blowing, conserving moisture during dry periods, and removing excess water during wet periods. Measures that prevent overgrazing help to maintain an adequate plant cover and thus help to control soil blowing. Surface drains are needed. Grazing when the soil is too wet may destroy forage plants. During the summer the soil often lacks sufficient moisture for optimum plant growth. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet or dry periods help to keep the pasture in good condition.

The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management group is 5b. The primary habitat type is TMC.

23B—Rousseau fine sand, 3 to 12 percent slopes. This deep, undulating and gently rolling, well drained soil is on ridges, knolls, and plains in the uplands. Individual areas are irregularly shaped or linear and range from 5 to 200 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand. In places the soil is coarser textured throughout. In some areas the lower part of the subsoil and the substratum are loamy.

Included with this soil in mapping are small areas of the poorly drained Deford and somewhat poorly drained Wainola soils in depressions and drainageways. These soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Rousseau soil, and the available water capacity is low. Surface runoff is slow.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. The main concerns in managing woodland are the equipment limitation, seedling mortality, and plant competition. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment during dry periods. The best sites for log landings are the nearly level included areas. Because of droughtiness, seedling losses may exceed 25 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

This soil is poorly suited to cropland, but such crops as oats, barley, corn, and a mixture of grasses and legumes can be grown. The main management needs are measures that control soil blowing, maintain the organic matter content, and conserve moisture during dry periods. Examples are buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. Plants that are seeded in the spring can make good use of the limited amount of available water.

This soil is fairly well suited to pasture. The main management concerns are conserving moisture during

dry periods and controlling soil blowing. During many dry periods, the soil lacks sufficient moisture for optimum plant growth. Overgrazing during dry periods increases the susceptibility to soil blowing. Rotation grazing or strip grazing and restricted use during dry periods conserve moisture and reduce the hazard of soil blowing.

The woodland ordination symbol is 5S, the land capability classification is IIIe, and the Michigan soil management group is 5.3a. The primary habitat type is AQVac, and the secondary habitat type is TMV.

23D—Rousseau fine sand, 15 to 25 percent slopes. This deep, rolling and hilly, well drained soil is on ridges and hills in the uplands. Individual areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand. In places the soil is coarser textured throughout.

Included with this soil in mapping are small areas of the poorly drained Deford and somewhat poorly drained Wainola soils on foot slopes and the somewhat excessively drained Mancelona soils on side slopes. Mancelona soils have a substratum of stratified sand and gravel. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Rousseau soil, and the available water capacity is low. Surface runoff is slow.

Most areas of this soil are used as woodland. The equipment limitation, the erosion hazard, seedling mortality, and plant competition are management concerns. The slope limits the use of equipment and the number of suitable landing sites. Special care is needed in laying out logging roads and in operating equipment. The roads should be designed so that they conform to the topography and should be built on the contour as much as possible. The sandy surface layer restricts the use of wheeled equipment during dry periods.

Erosion results from the concentration of runoff on skid trails, on logging roads, and in the tracks of wheeled equipment. Removing water with water bars, out-sloping road surfaces, culverts, and drop structures and building logging roads and skid roads on the contour or on gentle slopes help to prevent excessive soil loss.

Because of droughtiness, seedling losses may exceed 25 percent on this soil. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay reforestation. Plant competition can be controlled by chemical or mechanical means.

Crops are generally not grown on this soil because of the slope and the droughtiness. Overcoming these limitations generally is not practical. The soil is poorly suited to pasture. The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate plant cover by rotational grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

The woodland ordination symbol is 5R, the land capability classification is VIe, and the Michigan soil management group is 5.3a. The primary habitat type is AQVac, and the secondary habitat type is TMV.

24—Arnheim-Moquah complex, 0 to 3 percent slopes. These deep, nearly level soils are on flood plains along streams and rivers. They are occasionally flooded. The poorly drained Arnheim soil is in old stream channels. The moderately well drained Moquah soil is on low knolls and on ridges and terraces. Individual areas are linear and range from 5 to 100 acres in size. They are about 50 to 70 percent Arnheim soil and 20 to 35 percent Moquah soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Arnheim soil has a surface layer of black muck about 4 inches thick. The substratum to a depth of about 60 inches is mottled. The upper part is reddish brown and dark gray silt loam, the next part is stratified dark brown very fine sand and very dark gray silt loam, and the lower part is dark brown fine sand and dark grayish brown sand.

Typically, the Moquah soil has a surface layer of black loam about 2 inches thick. The substratum extends to a depth of 60 inches or more. In sequence downward, it is dark brown loam; reddish brown, mottled fine sandy loam; light brown, mottled fine sand; and yellowish red, mottled sand. In places the upper part of the substratum has less silt and clay.

Included with these soils in mapping are small areas of the very poorly drained Cathro soils in depressions. Also included are small areas of the well drained Nadeau and Rubicon soils on ridges and knolls in the uplands. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the Arnheim and Moquah soils. The available water capacity is high in the Arnheim soil and moderate in the Moquah soil. Surface runoff is medium on the Moquah soil and very slow or ponded on the Arnheim soil. From fall through spring, the Arnheim soil has a seasonal high water table within a depth of 1 foot and the Moquah soil has one at a depth of 3 to 6 feet.

Most areas of these soils are used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. The main limitation is the wetness in the lower areas. If wheeled skidders are used during wet periods, logging roads tend to be slippery and ruts form easily.

Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are the adjacent areas of well drained soils.

Because of the wetness in the lower areas, seedling mortality can be as high as 25 to 50 percent. Trees generally are not planted on these soils because of the high seedling mortality rate. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. Because of the wetness, trees in the lower areas are shallow rooted. They may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

These soils generally are not used as cropland or pasture because of the hazard of flooding and the wetness. Overcoming these generally is not practical.

The woodland ordination symbols are 5W and 3A, the land capability classification is Vw, and the Michigan soil management groups are L-2c and L-2a. The primary habitat type is FMC.

25B—Onaway-Rousseau complex, 3 to 12 percent slopes. These deep, undulating and gently rolling, well drained soils are on broad ridges and knolls in the uplands. Individual areas are irregularly shaped and range from 5 to 300 acres in size. They are 40 to 65 percent Onaway soil and 20 to 35 percent Rousseau soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 or more than 30 inches. In some areas the lower part of the subsoil has less clay.

Typically, the Rousseau soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand. In some areas the lower subsoil and the substratum are loamy. In other areas the soil is coarser textured throughout.

Included with these soils in mapping are small areas of the poorly drained Deford and Ensley soils in depressions and drainageways. Also included are small areas of the somewhat poorly drained Solona and Wainola soils in the slightly lower landscape positions. Included soils make up as much as 15 percent of the map unit.

Permeability is moderate in the Onaway soil and rapid in the Rousseau soil. The available water capacity is moderate in the Onaway soil and low in the Rousseau soil. Surface runoff is slow or medium on both soils.

Most areas of these soils are used as woodland. A few are used as cropland or pasture. The main concerns in managing woodland are the equipment limitation, plant competition, and seedling mortality. In heavily traveled areas of the Rousseau soil, loose sand can interfere with the traction of wheeled equipment during dry periods. In areas of the Onaway soil, the use of equipment may be briefly limited in the spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. The best sites for landings are the nearly level included areas.

When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means. Because of droughtiness, seedling losses may exceed 25 percent on the Rousseau soil. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion and soil blowing, maintain the organic matter content, and conserve moisture during dry periods. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, buffer strips, and field windbreaks.

These soils are well suited to pasture. The main management concern is conserving moisture during dry periods. Rotation grazing or strip grazing and restricted use during dry periods help to maintain forage production.

The woodland ordination symbols are 3A and 5S, the land capability classification is IIIe, and the Michigan soil management groups are 3a and 5.3a. The primary habitat type is AVO, and the secondary habitat type is ATD.

26B—Rubicon sand, 3 to 12 percent slopes. This deep, undulating and gently rolling, excessively drained soil is on ridges, knolls, and flats in the uplands. Individual areas are irregularly shaped and range from 5 to 300 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The surface layer is black and brown sand about 6 inches thick. The subsoil is loose sand about 30 inches thick. The upper part is strong brown, and the lower part is reddish yellow. The substratum to a depth of about 60 inches is light brown sand. In some areas the lower part of the subsoil and the substratum are loamy. In other areas the upper part of the soil is loamy.

Included with this soil in mapping are small areas of the poorly drained Deford and somewhat poorly drained Wainola soils in depressions and drainageways. These soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Rubicon soil, and the available water capacity is low. Surface runoff is slow.

Most areas of this soil are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment during dry periods. The best sites for log landings are the nearly level included areas. Because of droughtiness, seedling losses may exceed 25 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

Crops are generally not grown on this soil because of the droughtiness. Overcoming this limitation generally is not practical. The soil is poorly suited to pasture. The main concerns in managing pastured areas are controlling soil blowing and conserving moisture during dry periods. During many of these periods, the soil lacks sufficient moisture for optimum plant growth. Rotation or strip grazing and restricted use during dry periods conserve moisture and reduce the hazard of soil blowing.

The woodland ordination symbol is 4S, the land capability classification is VIs, and the Michigan soil management group is 5.3a. The primary habitat type is AQVib, and the secondary habitat type is TMV.

27A—Urban land-Rousseau complex, 0 to 3 percent slopes. This map unit consists of Urban land and a nearly level, moderately well drained Rousseau soil. The unit is on broad flats and low ridges in the uplands. Individual areas are irregularly shaped and range from 50 to 250 acres in size. They are 30 to 65 percent Urban land and 20 to 30 percent Rousseau soil. The Urban land and the Rousseau soil occur as areas so intricately mixed or so small that separating them in mapping was not practical.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the surface layer of the Rousseau soil is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink, mottled fine sand. In some areas it has thin bands of fine sandy loam or silt loam. In other areas the soil is well drained.

Included in this unit in mapping are small areas of the poorly drained Burleigh and Deford and somewhat poorly drained Wainola soils in depressions and drainageways. These soils make up 10 to 15 percent of the map unit.

Permeability is rapid in the Rousseau soil, and the available water capacity is low. Surface runoff is slow or very slow. Most areas of the unit are drained by sewer systems, drainage tile, and surface ditches. In areas that are not drained, the Rousseau soil has a seasonal high water table at a depth of 2.5 to 6.0 feet from fall through spring.

If the Rousseau soil is used for grasses, flowers, vegetables, trees, or shrubs, conserving moisture during dry periods and controlling soil blowing are the major management concerns. Frequent watering, mulching, and a cover of loamy topsoil increase the moisture supply. Perennial plants that are deep rooted should be selected for planting. If disturbed areas are left bare, soil blowing is a hazard. It can be controlled by minimizing the extent of the disturbed areas and by mulching.

This unit is not assigned to interpretive groups.

28A—Ingalls fine sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low, broad flats and in depressions and drainageways on uplands. Individual areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is black fine sand about 3 inches thick. The subsurface layer is grayish brown fine sand about 8 inches thick. The subsoil is mottled fine sand about 14 inches thick. The upper part is dark brown and very friable, the next part is reddish yellow and friable, and the lower part is strong brown and friable. The substratum to a depth of about 60 inches is light reddish brown and light gray, mottled, stratified silt loam and silt. In places the depth to the substratum is less than 20 or more than 40 inches. In some areas the substratum has layers of gravelly fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Burleigh and Deford soils in the lower landscape positions. Also included are small areas of the somewhat poorly drained Solona soils. Solona soils are loamy throughout. They are intermingled with areas of the Ingalls soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Ingalls soil and moderately slow in the loamy lower part. The available water capacity is moderate. Surface runoff

is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of this soil are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. Because of the seasonal wetness, the trees on this soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by chemical or mechanical means generally is needed to control the competing plants.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are removing excess water during wet periods, conserving moisture during dry periods, and maintaining the organic matter content. Soil blowing is a hazard. It can be controlled by cover crops, buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface. Conservation tillage and additions of organic material increase the available water capacity. A combination of surface and subsurface drains can lower the seasonal high water table, but locating drainage outlets may be difficult. Erosion-control structures may be needed where surface ditches enter drainageways. Unless they are protected, the tile lines can become plugged with sandy material.

This soil is well suited to pasture. The main management concern is conserving moisture during dry periods. Proper stocking rates, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbol is 4W, the land capability classification is IIIw, and the Michigan soil management group is 4/2b. The primary habitat type is TMC.

29—Burleigh mucky fine sand. This deep, nearly level, poorly drained soil is in upland depressions and drainageways. It is frequently ponded. Individual areas are irregularly shaped and range from 5 to 80 acres in size.

Typically, the surface layer is black muck about 4 inches thick. The upper part of the substratum is pale brown and brown, loose fine sand about 26 inches thick. The lower part to a depth of about 60 inches is mottled, brown and yellowish brown, stratified silt loam and very fine sand. In places the depth to the lower part of the substratum is more than 40 inches.

Included with this soil in mapping are small areas of Pickford and Tawas soils. The poorly drained Pickford soils are in landscape positions similar to those of the Burleigh soil. They have more silt and clay in the solum than the Burleigh soil. The very poorly drained Tawas soils are in the slightly lower landscape positions. They are organic to a depth of 15 to 51 inches. Also included are small areas of the well drained Rousseau soils on upland ridges and knolls. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the upper part of the Burleigh soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Most areas of this soil are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Ruts form easily if wheeled skidders are used during wet periods. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best sites for landings are the small included areas of well drained Rousseau soils.

Because of the wetness, the trees on this soil are shallow rooted and may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Because of the wetness, seedling mortality may exceed 50 percent. Trees generally are not planted on this soil because of the high seedling mortality rate.

Crops are generally not grown on this soil because of the high water table and the frost hazard. Overcoming these limitations generally is not practical. The soil is poorly suited to pasture, mainly because of the excess water. Surface and open ditches can remove the water, but in many places outlets are not readily available.

The woodland ordination symbol is 2W, the land capability classification is Vw, and the Michigan soil management group is 4/2c. The primary habitat type is FMC.

30B—Cunard-Onaway fine sandy loams, 0 to 6 percent slopes. These nearly level and undulating, well drained soils are on upland plains. The Cunard soil is moderately deep, and the Onaway soil is deep. Individual areas are irregularly shaped and range from 5 to 200 acres in size. They are 40 to 65 percent Cunard soil and 20 to 45 percent Onaway soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Cunard soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is black fine sandy loam about 4 inches thick. The next layer is mixed brown and dark brown fine sandy loam about 7 inches thick. The subsoil is about 13 inches thick. The upper part is yellowish red, friable fine sandy loam, and the lower part is reddish brown, friable gravelly fine sandy loam. The substratum is brown gravelly fine sandy loam. Limestone bedrock is at a depth of about 28 inches. In places the depth to bedrock is less than 20 inches.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In some areas the depth to the substratum is less than 15 or more than 30 inches. In other areas the lower part of the subsoil has less clay.

Included with these soils in mapping are small areas of the somewhat poorly drained Solona and Sundell and poorly drained Ensley and Nahma soils on foot slopes and in depressions and drainageways. These soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Cunard and Onaway soils. The available water capacity is moderate in the Onaway soil and low in the Cunard soil. Surface runoff is medium on both soils.

Most areas of these soils are used as woodland. A few are used as cropland or pasture. The windthrow hazard and plant competition are management concerns. The equipment limitation is moderate on landing sites. In other areas the use of equipment may be briefly limited in spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. In a few areas the bedrock underlying the Cunard soil interferes with road building. Because of the limited depth to bedrock, the trees are shallow rooted and may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion, maintain the organic matter content, and conserve moisture. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are well suited to pasture. Overgrazing can cause compaction and excessive runoff and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbol is 3A, the land capability classification is IIIe, and the Michigan soil management groups are 3/Ra and 3a. The primary habitat type is AVO, and the secondary habitat type is TM.

32A—Sundell-Ensign loams, 0 to 3 percent slopes. These nearly level, somewhat poorly drained soils are on broad upland flats. The Sundell soil is moderately deep, and the Ensign soil is shallow. Individual areas are irregularly shaped and range from 5 to 100 acres in size. They are 40 to 60 percent Sundell soil and 25 to 35 percent Ensign soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Sundell soil has about 2 inches of undecomposed forest litter at the surface. The surface layer is black loam about 7 inches thick. The subsoil is about 11 inches thick. The upper part is mixed dark brown and very dark gray, friable loam, and the lower part is brown, mottled, friable fine sandy loam. The substratum is brownish yellow, mottled fine sandy loam and yellowish red fine sandy loam. Limestone bedrock is at a depth of about 23 inches. In some places the depth to limestone is more than 40 inches. In other places the substratum is very gravelly coarse sand.

Typically, the Ensign soil has a surface layer of black loam about 5 inches thick. The next layer is mixed dark brown and brown, mottled fine sandy loam about 6 inches thick. The subsoil is strong brown, mottled, friable fine sandy loam. Limestone bedrock is at a depth of about 15 inches. In some areas the depth to limestone is less than 10 inches. In other areas the surface layer is flaggy.

Included with these soils in mapping are small areas of the poorly drained Nahma and Ruse soils in depressions and drainageways. Also included are small areas of the well drained Cunard and Summerville soils on low ridges and knolls. Included soils make up about 10 to 15 percent of the map unit.

Permeability is moderate in the Sundell and Ensign soils. The available water capacity is low in the Sundell soil and very low in the Ensign soil. Surface runoff is slow on both soils. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, seedling mortality, and plant competition are management concerns. The main limitation is the seasonal wetness. If wheeled skidders are used when the soils are wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result

in damage to tree roots and alteration of soil structure. Equipment should be used only when the soil is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. In a few areas the bedrock interferes with road building. The best landing sites are the small included areas of well drained Cunard and Summerville soils.

Because of the seasonal wetness and the limited depth to bedrock, the trees on these soils are shallow rooted and seedling mortality may exceed 25 percent. Some trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

These soils are generally unsuitable as cropland because of the limited depth to bedrock and the seasonal high water table. Overcoming these limitations generally is not practical.

These soils are poorly suited to pasture. The main management concerns are conserving moisture during dry periods and removing excess water during wet periods. During many dry periods, the soils lack sufficient moisture for plant growth. Rotation grazing or strip grazing and restricted use during dry periods help to maintain forage production. During wet periods excess water can be removed by surface drains.

The woodland ordination symbol is 2W, the land capability classification is Vw, and the Michigan soil management groups are 3/Rbc and Rbc. The primary habitat type is TMC, and the secondary habitat type is TM.

33—Nahma-Ruse complex. These nearly level, poorly drained soils are in broad, low areas and in depressions on uplands. They are frequently ponded. The Nahma soil is moderately deep, and the Ruse soil is shallow. Individual areas are irregularly shaped and range from 5 to 100 acres in size. They are 40 to 60 percent Nahma soil and 25 to 35 percent Ruse soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Nahma soil has a surface layer of black muck about 10 inches thick. The subsoil is dark grayish brown, mottled, firm loam about 7 inches thick. The substratum is reddish yellow, mottled gravelly sandy loam. Limestone bedrock is at a depth of about 23 inches. In places the depth to limestone is more than 40 inches.

Typically, the Ruse soil has a surface layer of black mucky loam about 6 inches thick. The subsoil is dark yellowish brown, friable loam about 6 inches thick. The substratum is yellowish brown and yellow, mottled gravelly sandy loam. Limestone bedrock is at a depth of about 18 inches. In places the depth to limestone is less than 10 inches.

Included with these soils in mapping are small areas of the very poorly drained Cathro and Chippeny soils in the slightly lower landscape positions. Also included are small areas of the well drained Summerville and somewhat poorly drained Sundell soils in the slightly higher positions. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderate in the Nahma soil and moderate or moderately rapid in the Ruse soil. The available water capacity is moderate in the Nahma soil and low in the Ruse soil. Surface runoff is slow on both soils. The seasonal high water table is near or above the surface from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Ruts form easily if wheeled skidders are used when the soils are wet. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the soil is frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. In a few areas the bedrock interferes with road building. The best landing sites are the small included areas of well drained Summerville soils.

Because of the seasonal wetness and the limited depth to bedrock, the trees on these soils are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Because of the wetness, seedling mortality may exceed 50 percent. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops are generally not grown on these soils because of the wetness and the limited depth to bedrock. Overcoming these limitations generally is not practical.

These soils are poorly suited to pasture, mainly because of the excess water and surface compaction. Overgrazing or grazing when the soils are wet can cause compaction and can destroy forage plants. Proper stocking rates, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 4W and 5W, the land capability classification is VIw, and the Michigan soil management groups are 3/Rbc and Rbc. The primary habitat type is TTM, and the secondary habitat type is FMC.

34—Urban land-Deford complex. This map unit consists of Urban land and a deep, nearly level, poorly drained Deford soil. The unit is on broad flats and in depressions and drainageways on uplands. The Deford soil is frequently ponded. Individual areas are irregularly shaped and range from 5 to 290 acres in size. They are 50 to 70 percent Urban land and 20 to 50 percent Deford soil. The Urban land and Deford soil occur as areas so intricately mixed or so small that separating them in mapping was not practical.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Deford soil has a surface layer of black muck and mucky fine sand about 7 inches thick. The substratum to a depth of about 60 inches is fine sand. It is grayish brown and mottled in the upper part and brown and dark reddish brown in the lower part. In some areas the soil has sand or gravelly sand in the substratum. In other areas the lower part of the substratum is gravelly fine sandy loam or silt loam.

Included in this unit in mapping are small areas of the very poorly drained Tawas soils in depressions. Also included are small areas of the well drained or moderately well drained Rousseau soils on slight rises and ridges. Included soils make up 10 to 15 percent of the map unit.

Permeability is rapid in the Deford soil. The available water capacity is low. Surface runoff is very slow or ponded. Some areas are artificially drained through sewer systems, drainage tile, and surface ditches. In areas that are not drained, the Deford soil has a seasonal high water table near or above the surface from fall through spring.

The Deford soil is used for building site development and for lawns and gardens. It is poorly suited to buildings, septic tank absorption fields, and recreational uses. It is suited to lawns and gardens and to trees and shrubs if excess water is removed. Several methods of artificial drainage can be used on this soil. The best method for a particular area should be determined by onsite evaluation. Perennial plants that have a fairly high tolerance for wetness generally should be selected for planting.

This unit is not assigned to interpretive groups.

35—Lupton-Tawas association. These deep, very poorly drained, nearly level soils are in swamps, depressions, and upland drainageways. They are frequently ponded. Generally, the Lupton soil is near the middle of the mapped areas and the Tawas soil is near the edges. Individual areas are linear or irregular in shape and range from 5 to more than 800 acres in size. They are 45 to 65 percent Lupton soil and 30 to 50 percent Tawas soil.

Typically, the Lupton soil is black muck to a depth of more than 60 inches. In some areas more than 10 inches of mucky peat is within 50 inches of the surface. In other areas marl is within 51 inches of the surface.

Typically, the Tawas soil has a surface layer of black mucky peat about 4 inches thick. The subsurface layer is black muck about 21 inches thick. The upper part of the substratum is black mucky fine sand. The lower part to a depth of about 60 inches is dark grayish brown sand. In some areas the substratum is sandy loam or silt loam. In other areas the organic material is less than 16 inches thick.

Included with these soils in mapping are small areas of the poorly drained Deford soils. These soils are at the edges of the mapped areas. Also included are small areas of the well drained Nadeau and Rousseau soils on knolls and ridges. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow to moderately rapid in the Lupton soil. It is moderately slow to moderately rapid in the organic part of the Tawas soil and rapid in the mineral substratum. The available water capacity is high in both soils. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall to summer.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. The soils generally are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Access to these soils is easiest during periods in winter when access roads are frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed.

Because of the wetness, the trees on these soils are shallow rooted and seedling mortality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees or leave them widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops are generally not grown on these soils because of the wetness, the instability of the organic material, and the frost hazard. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 2W and 5W, the land capability classification is Vw and VIw, and the Michigan soil management groups are Mc and M/4c. The primary habitat type is TTM, and the secondary habitat type is TTS.

36—Chippeny-Nahma mucks. These moderately deep, nearly level soils are in broad, low areas and in depressions on uplands. They are frequently ponded. The Chippeny soil is very poorly drained, and the Nahma soil is poorly drained. Individual areas are irregularly shaped and range from 5 to 200 acres in size. They are 40 to 60 percent Chippeny soil and 25 to 45 percent Nahma soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the upper 30 inches of the Chippeny soil is black muck. Limestone bedrock is at a depth of about 30 inches. In places the depth to limestone is more than 51 inches.

Typically, the Nahma soil has a surface layer of black muck about 10 inches thick. The subsoil is dark grayish brown, mottled, firm loam about 7 inches thick. The substratum is reddish yellow, mottled gravelly sandy loam. Limestone bedrock is at a depth of about 23 inches. In places the depth to limestone is less than 20 or more than 40 inches.

Included with these soils in mapping are small areas of the somewhat poorly drained Sundell soils on low knolls. Also included are small areas of the well drained Summerville soils on knolls and ridges. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderate or moderately slow in the Chippeny soil and moderate in the Nahma soil. The available water capacity is high in the Chippeny soil and moderate in the Nahma soil. Surface runoff is slow to ponded on both soils. The seasonal high water table is near or above the surface from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Many areas are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Equipment should be used only when the ground is frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. In some areas bedrock interferes with road building. The best sites for log landings are the small included areas of well drained Summerville soils.

Because of the wetness, the trees on this soil are shallow rooted and seedling mortality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops generally are not grown on these soils because of the excess water and the limited depth to bedrock. The soils are unsuited to pasture, mainly because of the excess water and surface compaction. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbol is 4W, the land capability classification is VIw, and the Michigan soil management groups are M/Rc and 3/Rbc. The primary habitat type is TTM, and the secondary habitat type is FMC.

37B—Mancelona-Nadeau complex, 0 to 8 percent slopes. These deep, nearly level to gently rolling soils are on flats and broad ridges in the uplands. The Mancelona soil is somewhat excessively drained, and the Nadeau soil is well drained. Individual areas are irregularly shaped and range from 5 to 170 acres in size. They are 35 to 60 percent Mancelona soil and 30 to 45 percent Nadeau soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Mancelona soil has a surface layer of very dark grayish brown loamy sand about 9 inches thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, very friable loamy sand, and the lower part is reddish brown, friable sandy loam. The substratum to a depth of about 60 inches is light yellowish brown, stratified sand and gravelly sand. In places the upper part of the soil is loamy fine sand.

Typically, the Nadeau soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable fine sandy loam; the next part is reddish brown, friable very gravelly sandy loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Banat and Gladwin and poorly drained Minocqua soils in depressions and drainageways and on foot slopes. These soils make up 5 to 10 percent of the map unit.

Permeability is moderately rapid in the upper part of the Mancelona soil and very rapid in the lower part. It is moderate in the upper part of the Nadeau soil and very rapid in the lower part. The available water capacity is low in the Mancelona soil and very low in the Nadeau soil. Surface runoff is slow on both soils.

Most areas of these soils are used as cropland. Some are used as woodland.

The main concerns in managing woodland are seedling mortality, the windthrow hazard, and plant competition. The best sites for landings are the nearly level included areas. Because of droughtiness, seedling

losses may be as high as 25 to 50 percent. Planting when the soils are moist can reduce these losses. Containerized seedlings or special planting stock can reduce the seedling mortality rate. Because of a high content of pebbles and cobbles, the trees on the Nadeau soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control soil blowing, maintain the organic matter content, and conserve moisture during dry periods. Examples are buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are well suited to pasture. The main concern in managing pastured areas is conserving moisture during dry periods, when the amount of moisture is insufficient for optimum plant growth. Overgrazing during these periods increases the susceptibility to soil blowing. Rotation grazing or strip grazing and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbols are 3S and 2S, the land capability classification is IIIs, and the Michigan soil management groups are 4a and 3/5a. The primary habitat type is TM, and the secondary habitat type is AQVib.

38A—Rousseau fine sand, 0 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on convex slopes and low knolls in the uplands. Individual areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink, mottled fine sand.

Included with this soil in mapping are small areas of the poorly drained Burleigh and Deford soils in depressions and drainageways. Also included are small areas of the somewhat poorly drained Wainola soils in the slightly lower landscape positions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Rousseau soil, and the available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 6.0 feet from fall through spring.

Most areas of this soil are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment during dry periods. Because of droughtiness, seedling losses may exceed 25 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control soil blowing, maintain the organic matter content, and conserve moisture during dry periods. Examples are buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. The main management concerns are conserving moisture and controlling soil blowing. During many dry periods, the soil lacks sufficient moisture for optimum plant growth. Rotation grazing or strip grazing and restricted use during dry periods conserve moisture and reduce the hazard of soil blowing.

The woodland ordination symbol is 5S, land capability classification is IIIs, and the Michigan soil management group is 5.3a. The primary habitat type is TMV, and the secondary habitat type is TMC.

40—Lupton muck, ponded. This deep, level, very poorly drained soil is in areas of marsh, much of which is ponded for most of the year. Individual areas are irregularly shaped and range from 5 to 150 acres in size.

Typically, the soil is black muck to a depth of more than 60 inches. In some areas the muck is underlain by sand or sandy loam. In other areas more than 10 inches of mucky peat is within 50 inches of the surface. In places marl is within 51 inches of the surface.

Included with this soil in mapping are small areas of the poorly drained Deford and Ensley soils. These soils make up about 5 percent of the map unit. Also included are small areas of open water, which make up 5 to 10 percent of the map unit.

These soils are well suited to habitat for wetland wildlife. They are unsuitable as woodland, cropland, and pasture.

The land capability classification is VIIIw. No other interpretive groups are assigned.

41—Aquents, sandy and loamy. These nearly level, poorly drained and somewhat poorly drained soils are in areas where the surface layer, the subsoil, and some of the substratum have been removed or where the original soil has been covered by fill. The texture ranges from

very gravelly coarse sand to silt loam. Individual areas are irregularly shaped and range from 5 to 50 acres in size.

Included with these soils in mapping are small areas of undulating to steep soils. These included soils are along the outer edges of the mapped areas. They make up 5 to 10 percent of the map unit.

The soil properties of the Aquents vary greatly. Generally, a water table is at a depth of 0.5 foot to 2.0 feet during wet periods.

In most areas these soils are idle and do not have a plant cover. In some areas they are used for building site development. The filled areas generally are unstable and thus are not suitable as sites for buildings.

These soils are not assigned to interpretive groups.

42—Pits, sand and gravel. This map unit consists of areas that have been excavated for sand or for sand and gravel. The exposed material supports few plants. Where the excavation extends below the water table, the bottom may be ponded seasonally or throughout the year. Individual areas range from 5 to 50 acres in size.

Most areas are idle or are still being mined. Onsite investigation is necessary to determine the suitability for specific uses.

This unit is not assigned to interpretive groups.

44—Tawas-Deford complex. These deep, nearly level soils are in depressions and drainageways. They are frequently ponded. The Tawas soil is very poorly drained, and the Deford soil is poorly drained. Individual areas are irregularly shaped and range from 10 to more than 150 acres in size. They are 30 to 55 percent Tawas soil and 30 to 40 percent Deford soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Tawas soil has a surface layer of black mucky peat about 4 inches thick. The subsurface layer is black muck about 21 inches thick. The upper part of the substratum is black mucky fine sand. The lower part to a depth of about 60 inches is dark grayish brown sand. In some places the muck is less than 16 or more than 51 inches thick. In other places the substratum is loamy.

Typically, the Deford soil has a surface layer of black muck and mucky fine sand about 7 inches thick. The substratum to a depth of about 60 inches is fine sand. It is grayish brown and mottled in the upper part and brown and dark reddish brown in the lower part. In some areas the soil has sand or gravelly sand in the substratum. In other areas the lower part of the substratum is loamy.

Included with these soils in mapping are small areas of the somewhat poorly drained Wainola soils in the slightly higher positions on the landscape. Also included are small areas of the well drained and moderately well drained Rousseau soils on ridges and knolls. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic part of the Tawas soil and rapid in the mineral part. It is rapid in the Deford soil. The available water capacity is high in the Tawas soil and low in the Deford soil. Surface runoff is very slow or ponded on both soils. The seasonal high water table is near or above the surface from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Many areas are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Equipment should be used only when the ground is frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best sites for log landings are the included areas of well drained Rousseau soils.

Because of the wetness, the trees on these soils are shallow rooted and seedling mortality may exceed 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Trees generally are not planted on these soils because of the high seedling mortality rate, plant competition, and low productivity.

Crops generally are not grown on these soils because of the wetness, the instability of the organic material, and the frost hazard. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 5W and 4W, the land capability classification is VIw, and the Michigan soil management groups are M/4c and 5c. The primary habitat type is TTM, and the secondary habitat type is FMC.

45C—Deford-Wainola-Rousseau complex, 0 to 12 percent slopes. This map unit consists of a deep, nearly level, poorly drained Deford soil; a deep, nearly level, somewhat poorly drained Wainola soil; and a deep, undulating and gently rolling, well drained Rousseau soil. The Deford soil is in depressions and swales and is frequently ponded. The Wainola soil is in the slightly higher landscape positions and on the lower side slopes of knolls and ridges. The Rousseau soil is on knolls and ridges. Individual areas are irregularly shaped and range from 15 to more than 1,000 acres in size. They are 25 to 40 percent Deford soil, 20 to 35 percent Wainola soil, and 15 to 20 percent Rousseau soil. The three soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Deford soil has a surface layer of black muck and mucky fine sand about 7 inches thick. The

substratum to a depth of about 60 inches is fine sand. It is grayish brown and mottled in the upper part and brown and dark reddish brown in the lower part. In places the substratum is sand or gravelly sand. In some areas the lower part of the substratum is gravelly fine sandy loam or silt loam.

Typically, the Wainola soil has about 2 inches of black, well decomposed organic material at the surface. The surface layer is pinkish gray fine sand about 10 inches thick. The subsoil is mottled fine sand about 29 inches thick. The upper part is reddish brown and very friable, the next part is strong brown and very friable, and the lower part is brown and loose. The substratum to a depth of about 60 inches is brown very fine sand. In some areas the soil is coarser sand throughout. In other areas the substratum is gravelly fine sandy loam or silt loam.

Typically, the Rousseau soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand. In places the soil is coarser sand throughout.

Included with these soils in mapping are small areas of the poorly drained Ensley and somewhat poorly drained Solona soils in depressions and drainageways. These included soils are dominantly loamy throughout. Also included are small areas of the very poorly drained Tawas soils in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Deford, Wainola, and Rousseau soils, and the available water capacity is low. Surface runoff is very slow or ponded on the Deford soil and slow on the Wainola and Rousseau soils. From fall through spring, the Deford soil has a seasonal high water table near or above the surface and the Wainola soil has one at a depth of 0.5 foot to 1.5 feet.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness in the lower areas. Ruts form easily if wheeled skidders are used during wet periods. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. Loose sand in some heavily traveled areas can interfere with the traction of wheeled equipment during dry periods. The best landing sites are the included areas of well drained Rousseau soils.

Because of wetness, the trees in the lower areas are shallow rooted and may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants.

Because of the wetness in the lower areas and droughtiness in areas of the well drained Rousseau soil, seedling mortality may exceed 50 percent. Trees are generally not planted in the lower areas because of the high seedling mortality rate. Planting containerized seedlings, overstocking, and planting when the soil is moist improve seedling survival on the Rousseau soil.

Crops are generally not grown on these soils because of the wetness and a scarcity of drainage outlets in the lower areas and the droughtiness of the Rousseau soil. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 4W, 6W, and 5S; the land capability classification is Vw; and the Michigan soil management groups are 5c, 5b, and 5.3a. The primary habitat type is FMC, and the secondary habitat type is TMC.

46—Pickford mucky silty clay loam. This deep, nearly level, poorly drained soil is in depressions, drainageways, and broad, low areas on uplands. It is frequently ponded. Individual areas are irregularly shaped and range from 5 to 180 acres in size.

Typically, the surface layer is about 3 inches of dark reddish brown mucky peat and black muck. The subsoil is mottled, firm silty clay loam about 21 inches thick. The upper part is dark gray and brown, and the lower part is reddish brown. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay loam. In some areas the upper 8 to 15 inches is muck. In other areas the soil has less clay throughout.

Included with this soil in mapping are small areas of the poorly drained Burleigh and Deford soils. These soils are sandier throughout than the Pickford soil. They are in landscape positions similar to those of the Pickford soil. Also included are small areas of the very poorly drained, organic Cathro soils in depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability is very slow in the Pickford soil, and the available water capacity is high. Surface runoff is slow to ponded. The seasonal high water table is near or above the surface from fall through spring.

Most areas of this soil are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness. Ruts form easily if wheeled skidders are used on this soil. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill,

gravel, and culverts are needed. The best sites for log landings are the adjacent areas of well drained soils.

Because of the wetness, the trees on this soil are shallow rooted and may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Because of the wetness, seedling mortality may exceed 50 percent. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

Crops are generally not grown on this soil because of the high water table and the frost hazard. Overcoming these limitations generally is not practical.

This soil is poorly suited to pasture, mainly because of the excess water and surface compaction. Overgrazing or grazing when the soil is wet can cause compaction and can destroy forage plants. Proper stocking rates, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbol is 6W, the land capability classification is Vw, and the Michigan soil management group is 1.5c. No habitat type is assigned.

49C—Cathro-Solona-Onaway complex, 0 to 15 percent slopes. This map unit consists of a deep, nearly level, very poorly drained Cathro soil; a deep, nearly level and undulating, somewhat poorly drained Solona soil; and a deep, undulating and gently rolling, well drained Onaway soil. The Cathro soil is in broad, low areas and is frequently ponded. The Solona soil is on the slightly higher convex slopes and low knolls in the uplands. The Onaway soil is on upland ridges and knolls. Individual areas are irregularly shaped and range from 5 to more than 150 acres in size. They are 30 to 50 percent Cathro soil, 20 to 30 percent Solona soil, and 15 to 25 percent Onaway soil. The three soils occur in areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the upper 22 inches of the Cathro soil is black muck. The subsurface layer is very dark gray fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is very dark gray, grayish brown, and light yellowish brown, mottled sandy loam. In some places the muck is more than 51 inches thick. In other places the substratum is sand or loamy sand.

Typically, the Solona soil has a surface layer of black loam about 2 inches thick. The subsoil is about 22 inches thick. In sequence downward, it is mixed black and brown loam; brown, friable loam; yellowish red, mottled, friable loam; and brown, mottled, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam. In some areas it is very gravelly coarse sand.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 or more than 30 inches. In some areas the lower part of the subsoil has less clay.

Included with these soils in mapping are small areas of the poorly drained Ensley and Minocqua soils in depressions and drainageways. Also included are small areas of the well drained Nadeau soils, which are intermingled with areas of the Onaway soil and have more sand and gravel in the substratum than that soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic part of the Cathro soil and moderate or moderately slow in the mineral part. It is moderate in the Onaway and Solona soils. The available water capacity is high in the Cathro soil and moderate in the Onaway and Solona soils. Surface runoff is very slow or ponded on the Cathro soil, slow on the Solona soil, and medium on the Onaway soil. From fall through spring, the Cathro soil has a seasonal high water table near or above the surface and the Solona soil has one at a depth of 1 to 3 feet.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation in the low areas is wetness. Areas of the organic Cathro soil are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are the less sloping areas of the well drained Onaway soil.

Because of wetness, the trees in the lower areas are shallow rooted. Many are blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Because of the wetness, seedling mortality may exceed 50 percent in the lower areas. Trees generally are not planted in these areas because of the high seedling mortality rate.

Crops generally are not grown on these soils, mainly because of the wetness and the frost hazard. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 5W, 3W, and 3A; the land capability classification is VIw; and the

Michigan soil management groups are M/3c, 3b, and 3a. The primary habitat type is TTM, and the secondary habitat type is TM.

50B—Grayling sand, 3 to 12 percent slopes. This deep, undulating and gently rolling, excessively drained soil is on upland plains. Individual areas are irregularly shaped and range from 5 to more than 500 acres in size.

Typically, the surface layer is black sand about 4 inches thick. The subsoil is strong brown sand about 26 inches thick. The upper part is very friable, and the lower part is loose. The substratum to a depth of about 60 inches is reddish yellow sand. In places the soil is fine sand throughout.

Included with this soil in mapping are small areas of the poorly drained Deford and somewhat poorly drained Wainola soils in depressions and drainageways. Also included are small areas of the well drained Pemene soils. These soils are in landscape positions similar to those of the Grayling soil. They have a moderate available water capacity. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Grayling soil, and the available water capacity is very low. Surface runoff is slow.

Most areas of this soil are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment during dry periods. The best sites for log landings are the nearly level included or adjacent areas. Because of droughtiness, seedling losses may exceed 50 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate.

Crops generally are not grown on this soil because of the droughtiness and the hazard of soil blowing. Pastures furnish very little forage for livestock. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbol is 4S, the land capability classification is VIs, and the Michigan soil management group is 5.7a. The primary habitat type is AQVac, and the secondary habitat type is QAE.

51B—Pemene-Rubicon complex, 3 to 12 percent slopes. These deep, undulating and gently rolling soils are on upland ridges and knolls. The Pemene soil is well drained, and the Rubicon soil is excessively drained. Individual areas are irregularly shaped and range from 5 to 1,920 acres in size. They are about 50 to 70 percent Pemene soil and 20 to 30 percent Rubicon soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Pemene soil has about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is black loamy fine sand about 2 inches thick. The subsurface layer is brown loamy fine sand about 13 inches thick. The next 6 inches is mixed brown loamy fine sand and reddish brown fine sandy loam. The subsoil is about 16 inches thick. The upper part is reddish brown, friable fine sandy loam, and the lower part is yellowish red, friable loamy sand. The upper part of the substratum is light reddish brown gravelly loamy sand. The lower part to a depth of about 60 inches is reddish yellow loamy sand. In places sandstone bedrock is at a depth of 20 to 40 inches.

Typically, the Rubicon soil has about 1 inch of well decomposed forest litter at the surface. The surface layer is black and brown sand about 6 inches thick. The subsoil is loose sand about 30 inches thick. The upper part is strong brown, and the lower part is reddish yellow. The substratum to a depth of about 60 inches is light brown sand. In some areas the soil is fine sand throughout. In other areas it is fine sandy loam or loam below a depth of 20 inches.

Included with these soils in mapping are small areas of the poorly drained Deford and Ensley and somewhat poorly drained Solona soils in depressions, in drainageways, and on foot slopes. Also included are small areas of the well drained Nadeau soils. These soils are in landscape positions similar to those of the Pemene and Rubicon soils. They have more pebbles and cobbles in the subsoil than the Pemene and Rubicon soils. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately rapid or moderate in the upper part of the Pemene soil and moderately rapid in the lower part. It is rapid in the Rubicon soil. The available water capacity is moderate in the Pemene soil and low in the Rubicon soil. Surface runoff is slow on both soils.

Most areas of these soils are used as woodland. A few are used as cropland or pasture. The major concerns in managing woodland are the equipment limitation, seedling mortality, and plant competition. In some areas loose sand can interfere with the traction of wheeled equipment during dry periods. Suitable landing sites are available in the small included or adjacent areas of nearly level soils. Because of droughtiness, seedling losses may be as high as 25 to 50 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay reforestation. Plant competition can be controlled by mechanical or chemical means.

These soils are poorly suited to crops, but such crops as oats, barley, potatoes, corn, and a mixture of grasses and legumes can be grown. The main management needs are measures that control erosion and soil blowing, maintain the organic matter content, and conserve moisture during dry periods. Examples are crop rotations that include grasses and legumes, cover crops,

crop residue management, grassed waterways, contour stripcropping, a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, buffer strips, and field windbreaks.

These soils are fairly well suited to pasture. The main management concern is conserving moisture during dry periods. Proper stocking rates, rotation grazing or strip grazing, and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbol is 4S, the land capability classification is IVe, and the Michigan soil management groups are 4a and 5.3a. The primary habitat type is AQVib, and the secondary habitat type is TMV.

52B—Onaway-Nadeau fine sandy loams, 3 to 12 percent slopes. These deep, well drained, undulating and gently rolling soils are on ridges and knolls in the uplands. Individual areas are irregularly shaped and range from 10 to more than 270 acres in size. They are 40 to 65 percent Onaway soil and 20 to 40 percent Nadeau soil. The two soils occur in areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 or more than 30 inches. In some areas the lower part of the subsoil has less clay.

Typically, the Nadeau soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper layer is brown, friable fine sandy loam; the next part is reddish brown, friable very gravelly sandy loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand. In places the upper part of the soil is sand or loamy sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Banat and Solona and poorly drained Ensley and Minocqua soils in depressions, in drainageways, and on foot slopes. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Onaway soil. It is moderate in the upper part of the Nadeau soil and very rapid in the lower part. The available water capacity is moderate in the Onaway soil and very low in the Nadeau soil. Surface runoff is medium on both soils.

Most areas of these soils are used as woodland. A few are used as cropland or pasture. The major concerns in managing woodland are plant competition and the windthrow hazard. The equipment limitation is moderate on landing sites. In other areas the use of equipment may be briefly limited in spring and in other excessively wet periods. The best sites for landings are the nearly level included areas. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means. Because of a high content of pebbles and cobbles, the trees on the Nadeau soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control erosion and maintain the organic matter content. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are well suited to pasture. Overgrazing can cause compaction and excessive runoff and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 3A and 2S, the land capability classification is IIIe, and the Michigan soil management groups are 3a and 3/5a. The primary habitat type is AVO, and the secondary habitat type is TM.

52D—Onaway-Nadeau fine sandy loams, 12 to 35 percent slopes. These deep, well drained, rolling to steep soils are on hills and ridges in the uplands. Individual areas are irregularly shaped and range from 10 to 120 acres in size. They are 40 to 60 percent Onaway soil and 30 to 45 percent Nadeau soil. The two soils occur in areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 inches. In some areas the lower part of the subsoil has less clay.

Typically, the Nadeau soil has about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, friable fine sandy loam; the next part is reddish brown, friable very gravelly sandy

loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Banat and Solona and poorly drained Ensley and Minocqua soils in depressions and drainageways and on foot slopes. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the Onaway soil. It is moderate in the upper part of the Nadeau soil and very rapid in the lower part. The available water capacity is moderate in the Onaway soil and very low in the Nadeau soil. Surface runoff is medium or rapid on both soils.

Most areas of these soils are used as woodland. The equipment limitation, the erosion hazard, the windthrow hazard, and plant competition are management concerns. The slope limits the use of equipment and the number of suitable landing sites. Special care is needed in laying out logging roads and in operating equipment. The roads should be designed so that they conform to the topography and should be built on the contour as much as possible.

Erosion results from the concentration of runoff on skid trails, on logging roads, and in the tracks of wheeled equipment. It can be minimized by locating logging roads and skid trails on gentle grades; by removing water with water bars, out-sloping road surfaces, and culverts; and by seeding skid roads and trails after logging activities are complete.

Because of a high content of pebbles and cobbles, the trees on the Nadeau soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

Crops generally are not grown on these soils because of the slope and a severe hazard of erosion. Overcoming these limitations generally is not practical.

These soils are poorly suited to pasture. The main concerns in managing pastured areas are conserving moisture and controlling erosion. During many dry periods, these soils lack sufficient moisture for optimum plant growth. Rotation grazing or strip grazing, measures that maintain a protective plant cover, and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbols are 3R and 2R, the land capability classification is VIe, and the Michigan soil management groups are 3a and 3/5a. The primary habitat type is AVO, and the secondary habitat type is TM.

53B—Pemene-Rousseau-Rock outcrop complex, 3 to 12 percent slopes. This map unit occurs as areas of deep, undulating and gently rolling, well drained Pemene and Rousseau soils intermingled with areas of Rock outcrop. The unit is on upland knolls and ridges. Individual areas are irregularly shaped and range from 10 to 150 acres in size. They are 45 to 60 percent Pemene soil, 15 to 35 percent Rousseau soil, and 10 to 20 percent Rock outcrop. The two soils and Rock outcrop occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Pemene soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is black loamy fine sand about 2 inches thick. The subsurface layer is brown loamy fine sand about 13 inches thick. The next 5 inches is mixed brown loamy fine sand and reddish brown fine sandy loam. The subsoil is about 16 inches thick. The upper part is reddish brown, friable fine sandy loam, and the lower part is yellowish red, friable loamy sand. The substratum to a depth of about 60 inches is loamy sand. It is light reddish brown in the upper part and reddish yellow in the lower part.

Typically, the Rousseau soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand. In some areas the lower part of the subsoil and the substratum are loamy. In places the soil is coarser textured throughout.

Included in this unit in mapping are small areas of the poorly drained Deford and Ensley soils on foot slopes and in depressions and drainageways. Also included are small areas where bedrock is at a depth of 20 to 40 inches. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderate or moderately rapid in the upper part of the Pemene soil and moderately rapid in the lower part. It is rapid in the Rousseau soil. The available water capacity is moderate in the Pemene soil and low in the Rousseau soil. Surface runoff is slow on both soils.

Most areas of the Pemene and Rousseau soils are used as woodland. The major concerns in managing woodland are the equipment limitation, seedling mortality, and plant competition. In some areas loose sand can interfere with the traction of wheeled equipment during dry periods. The best sites for landings are the nearly level included areas. Rock outcrops can hinder road construction and harvesting activities.

Because of droughtiness, seedling losses may be 25 to 50 percent. Planting when the soils are moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant

competition can be controlled by mechanical or chemical means.

Crops and pasture plants generally are not grown on this map unit because of the Rock outcrop. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols assigned to the Pemene and Rousseau soils are 4S and 5S, the land capability classification is VIe, and the Michigan soil management groups are 4a and 5.3a. The primary habitat type is AQVib, and the secondary habitat type is TMV.

54C—Tawas-Banat-Nadeau complex, 0 to 15 percent slopes. This map unit consists of a deep, nearly level, very poorly drained Tawas soil; a deep, nearly level and undulating, somewhat poorly drained Banat soil; and a deep, undulating and rolling, well drained Nadeau soil. The Tawas soil is in broad, low areas, depressions, and drainageways. It is frequently ponded. The Banat soil is on the slightly higher convex slopes and low knolls in the uplands. The Nadeau soil is on upland ridges and knolls. Individual areas are irregularly shaped and range from 10 to 700 acres in size. They are 30 to 55 percent Tawas soil, 15 to 30 percent Banat soil, and 15 to 30 percent Nadeau soil. The three soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the upper 4 inches of the Tawas soil is black mucky peat. The subsurface layer is black muck about 21 inches thick. The upper part of the substratum is black mucky fine sand. The lower part to a depth of about 60 inches is dark grayish brown sand. In places the substratum is fine sandy loam or silt loam. In some areas the organic material is less than 16 inches thick.

Typically, the Banat soil has about 3 inches of black, well decomposed organic material at the surface. The surface layer is black silt loam about 3 inches thick. The next layer is mixed brown and strong brown silt loam about 3 inches thick. The subsoil is about 16 inches thick. It is mottled. The upper part is dark brown, friable loam; the next part is strong brown, friable very gravelly sandy loam; and the lower part is strong brown, loose very gravelly loamy coarse sand. The substratum to a depth of about 60 inches is strong brown very gravelly coarse sand. In places the upper part of the soil is sand or loamy sand.

Typically, the Nadeau soil has about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable fine sandy loam; the next part is reddish brown, friable very gravelly sandy loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand. In places the upper part of the soil is sand or loamy sand.

Included with these soils in mapping are areas of the poorly drained Ensley and Minocqua soils in depressions and drainageways and the well drained Onaway soils on ridges and knolls. Onaway soils are loamy throughout. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic part of the Tawas soil and rapid in the sandy substratum. It is moderate in the upper part of the Banat and Nadeau soils and very rapid in the lower part. The available water capacity is very low in the Banat and Nadeau soils and high in the Tawas soil. Surface runoff is very slow or ponded on the Tawas soil, slow on the Banat soil, and moderate on the Nadeau soil. The Tawas soil has a seasonal high water table near or above the surface from fall to summer. The Banat soil has one at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness in the low areas. Areas of the organic Tawas soil are not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment may be needed. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are the less sloping areas of the well drained Nadeau soil.

Because of the wetness in the low areas and a high content of cobbles and pebbles in the better drained soils, trees are shallow rooted on this unit. Many may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Because of wetness, seedling mortality may exceed 50 percent in the lower areas. Trees are generally not planted in these areas because of the high seedling mortality rate.

Crops and pasture plants generally are not grown on these soils, mainly because of the wetness and the frost hazard. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 5W, 2W, and 2S; the land capability classification is VIw; and the Michigan soil management groups are M/4c, 3/5b, and 3/5a. The primary habitat type is TTM, and the secondary habitat type is TM.

55B—Nadeau-Summerville fine sandy loams, 3 to 12 percent slopes. These well drained, undulating and gently rolling soils are on upland plains. The Nadeau soil is deep, and the Summerville soil is shallow. Individual areas are irregularly shaped and range from 10 to 90 acres in size. They are 40 to 60 percent Nadeau soil and

30 to 50 percent Summerville soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Nadeau soil has about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable fine sand; the next part is reddish brown, friable very gravelly sandy loam; and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand.

Typically, the Summerville soil has a surface layer of very dark grayish brown fine sandy loam about 2 inches thick. The subsoil is friable fine sandy loam about 14 inches thick. The upper part is brown, and the lower part is dark brown. Limestone bedrock is at a depth of about 16 inches. In places the depth to limestone is more than 20 or less than 10 inches.

Included with these soils in mapping are small areas of the somewhat poorly drained Banat and Sundell and poorly drained Nahma and Minocqua soils in depressions, in drainageways, and on foot slopes. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the upper part of the Nadeau soil and very rapid in the lower part. It is moderate in the Summerville soil. The available water capacity is low in the Summerville soil and very low in the Nadeau soil. Surface runoff is slow on both soils.

Most areas of these soils are used as woodland. The major concerns in managing woodland are the windthrow hazard, seedling mortality, and plant competition. The equipment limitation is moderate on landing sites. In a few areas bedrock interferes with road building. The best sites for landings are the small included areas of nearly level soils.

Because of the shallow depth to bedrock in the Summerville soil and a high content of pebbles and cobbles in the Nadeau soil, trees on this unit are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Because of droughtiness, seedling losses are as high as 25 to 50 percent in some areas. Planting when the soils are moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

These soils are poorly suited to cropland, but such crops as oats, barley, corn, and a mixture of grasses and legumes can be grown. The main management concerns are the shallow depth to bedrock in the Summerville soil, the high content of cobbles and flagstones in the Nadeau soil, and the droughtiness of both soils. Cobbles and flagstones in the surface layer can hinder seedbed preparation and harvesting activities unless they are removed and stockpiled. Cover crops, crop residue management, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface conserve moisture. Small grain crops that are seeded early in spring can make good use of the limited amount of available water.

These soils are fairly well suited to pasture. The main concern in managing pastured areas is conserving moisture during dry periods, when the amount of moisture is insufficient for optimum plant growth. Rotation grazing or strip grazing and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbols are 2S and 3D, the land capability classification is IVe, and the Michigan soil management groups are 3/5a and Ra. The primary habitat type is TMV, and the secondary habitat type is AQVib.

56A—Amasa very fine sandy loam, 0 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on slightly convex slopes and low knolls. Individual areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is black very fine sandy loam about 1 inch thick. The subsurface layer is brown very fine sandy loam about 2 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish red and strong brown, friable very fine sandy loam, and the lower part is brown, mottled, very friable loamy sand. The substratum to a depth of about 60 inches is reddish yellow, mottled sand. In places the upper part of the soil is loamy fine sand.

Included with this soil in mapping are small areas of the poorly drained Deford soils in depressions and drainageways and the well drained and moderately well drained Rousseau soils on ridges and knolls. Rousseau soils do not have a texture of very fine sandy loam in the upper part. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the upper part of the Amasa soil and rapid in the lower part. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 6.0 feet from fall through spring.

Most areas of this soil are used as woodland. The major management concern is plant competition. When openings are made in the canopy, invading plants can prevent or delay reforestation. The unwanted species can be controlled by mechanical or chemical means.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management concerns are controlling soil blowing, maintaining the organic matter content, and conserving moisture during dry periods. Buffer strips, vegetative barriers, field windbreaks, and a system of conservation

tillage that does not invert the soil and that leaves all or part of the crop residue on the surface help to control soil blowing. Cover crops, green manure crops, crop residue management, and additions of organic material increase the organic matter content and the available water capacity.

This soil is well suited to pasture. The main management concern is conserving moisture during dry periods, when the amount of moisture is insufficient for optimum plant growth. Rotation grazing or strip grazing and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbol is 3A, the land capability classification is IIs, and the Michigan soil management group is 3/5a. The primary habitat type is AQVib, and the secondary habitat type is ATD.

58A—Banat silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low plains and in depressions and drainageways. Individual areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, about 3 inches of black, well decomposed organic material is at the surface. The surface layer is black silt loam about 3 inches thick. The next layer is mixed brown and strong brown silt loam about 3 inches thick. The subsoil is about 16 inches thick. It is mottled. The upper part is dark brown, friable loam; the next part is strong brown, friable very gravelly sandy loam; and the lower part is strong brown, loose very gravelly loamy coarse sand. The substratum to a depth of about 60 inches is strong brown very gravelly coarse sand.

Included with this soil in mapping are small areas of the well drained Nadeau soils on knolls and ridges and the poorly drained Minocqua and very poorly drained Tawas soils in depressions. Included soils make up about 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of the Banat soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. The equipment limitation, the windthrow hazard, and plant competition are the main concerns in managing woodland. The main limitation is the seasonal wetness. If wheeled skidders are used when the soil is wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are the included small areas of well drained Nadeau soils.

Because of the seasonal wetness, the trees on this soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that remove excess water during wet periods, conserve moisture during dry periods, and maintain the organic matter content. A combination of surface and subsurface drains can lower the seasonal high water table if suitable drainage outlets are available. Erosion-control structures may be needed where surface ditches enter drainageways. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface and additions of organic material increase the organic matter content and the available water capacity.

This soil is well suited to pasture. The main management concern is removing excess water during wet periods. Surface drains are effective if drainage outlets are available.

The woodland ordination symbol is 2W, the land capability classification is IIIw, and the Michigan soil management group is 3/5b. The primary habitat type is TM.

59B—Nahma-Sundell-Summerville complex, 0 to 6 percent slopes. This map unit consists of a moderately deep, nearly level, poorly drained Nahma soil; a moderately deep, nearly level and undulating, somewhat poorly drained Sundell soil; and a shallow, nearly level and undulating, well drained Summerville soil. The Nahma soil is on low flats and in depressions and drainageways. It is frequently ponded. The Sundell soil is on the slightly higher flats. The Summerville soil is on upland flats and knolls. Individual areas are irregularly shaped and range from 50 to more than 200 acres. They are 30 to 45 percent Nahma soil, 30 to 40 percent Sundell soil, and 15 to 25 percent Summerville soil. The three soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Nahma soil has a surface layer of black muck about 10 inches thick. The subsoil is dark grayish brown, mottled, firm loam about 7 inches thick. The substratum is reddish yellow, mottled gravelly sandy loam. Limestone bedrock is at a depth of about 23 inches. In some places the depth to limestone is less than 20 or more than 40 inches. In other places the muck is more than 16 inches thick.

Typically, the Sundell soil has about 2 inches of undecomposed forest litter at the surface. The surface layer is black loam about 7 inches thick. The subsoil is

about 11 inches thick. The upper part is mixed very dark gray and dark brown, friable loam, and the lower part is brown, mottled, friable fine sandy loam. The substratum is fine sandy loam. It is brownish yellow and mottled in the upper part and yellowish red in the lower part. Limestone bedrock is at about 23 inches. In places the depth to limestone is less than 20 or more than 40 inches.

Typically, the Summerville soil has a surface layer of very dark grayish brown fine sandy loam about 2 inches thick. The subsoil is friable fine sandy loam about 14 inches thick. The upper part is brown, and the lower part is dark brown. Limestone bedrock is at a depth of about 16 inches. In places the depth to limestone is less than 10 or more than 20 inches.

Included with these soils in mapping are small areas of the deep, well drained Onaway soils on ridges and knolls. Also included are small areas of the very poorly drained Cathro soils in depressions and drainageways. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Nahma, Sundell, and Summerville soils. The available water capacity is low in the Summerville and Sundell soils and moderate in the Nahma soil. Surface runoff is slow on the Summerville and Sundell soils and very slow or ponded on the Nahma soil. From fall through spring, the Sundell soil has a seasonal high water table at a depth of 0.5 foot to 1.5 feet and the Nahma soil has one near or above the surface.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The main limitation is the wetness in the low areas. Ruts form easily if wheeled skidders are used. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. In a few areas the underlying bedrock interferes with road building. The best landing sites are the less sloping areas of the well drained Summerville soil.

Because of the wetness of the Nahma and Sundell soils and the limited depth to bedrock in all three soils, the trees on this unit are shallow rooted and seedling losses may be as high as 25 to 50 percent. Many trees may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay natural regeneration unless precautionary measures are applied. Special harvest methods are needed to control the undesirable plants. Trees generally are not planted on these soils.

Crops are generally not grown on these soils because of the wetness in the lower areas and the limited depth to bedrock in the higher areas. Overcoming the limitations that affect crops and pasture generally is not practical.

The woodland ordination symbols are 4W, 2W, and 3D; the land capability classification is Vw; and the Michigan soil management groups are 3/Rc, 3/Rb, and Ra. The primary habitat type is TTM, and the secondary habitat type is TM.

60B—Onaway-Solona complex, 0 to 10 percent slopes. These deep soils are on uplands. The nearly level to gently rolling, well drained Onaway soil is on ridges and knolls. The nearly level and undulating, somewhat poorly drained Solona soil is in depressions and drainageways and on foot slopes. Individual areas are irregularly shaped and range from 20 to 200 acres in size. They are 40 to 70 percent Onaway soil and 20 to 35 percent Solona soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 inches. In some areas the lower part of the subsoil has less clay.

Typically, the Solona soil has a surface layer of black loam about 2 inches thick. The subsoil is about 22 inches thick. In sequence downward, it is mixed brown and black loam; brown, friable loam; yellowish red, mottled, friable loam; and brown, mottled, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam. In places it is very gravelly coarse sand.

Included with these soils in mapping are small areas of the poorly drained Ensley soils in depressions. Also included are small areas of the well drained Nadeau soils in landscape positions similar to those of the Onaway soil. Nadeau soils have a very low available water capacity. Included soils make up about 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Onaway and Solona soils. Surface runoff is medium on the Onaway soil and slow on the Solona soil. The Solona soil has a seasonal high water table at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. The main limitation is the seasonal wetness of the Solona soil. If wheeled skidders are used when this soil is wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage

to tree roots and alteration of soil structure. Equipment should be used only when the soil is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best sites for landings are the nearly level areas of the Onaway soil.

Because of the wetness, the trees on the Solona soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay regeneration. Plant competition can be controlled by mechanical or chemical means.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion, remove excess water from low areas, and maintain good tilth. Erosion can be controlled by cover crops, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. A combination of surface and subsurface drains can lower the seasonal high water table if suitable drainage outlets are available. Erosion-control structures may be needed where surface ditches enter drainageways. In low areas, machinery may bog down during wet periods and crusting may occur. Limiting the use of equipment during wet periods helps to maintain good tilth.

These soils are well suited to pasture. The main management concern is preventing surface compaction. Grazing when the soils are too wet can cause compaction and can destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 3A and 3W, the land capability classification is IIIe, and the Michigan soil management groups are 3a and 3b. The primary habitat type is ATD, and the secondary habitat type is TM.

61B—Pemene-Nadeau complex, 3 to 12 percent slopes. These deep, undulating and gently rolling, well drained soils are on upland ridges and knolls. Individual areas are irregularly shaped and range from 5 to 265 acres in size. They are 40 to 65 percent Pemene soil and 25 to 40 percent Nadeau soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Pemene soil has about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is black loamy fine sand about 2 inches thick. The subsurface layer is brown loamy fine sand about 13 inches thick. The next 5 inches is mixed brown loamy fine sand and reddish brown fine sandy loam. The subsoil is about 16 inches thick. The upper part is reddish brown, friable fine sandy loam, and the lower part is yellowish red, friable loamy sand. The upper part of the substratum is light reddish brown gravelly loamy sand. The lower part to a depth of about 60 inches is reddish yellow loamy sand.

Typically, the Nadeau soil has about 2 inches of black, partially decomposed leaf litter at the surface. The surface layer is dark brown fine sandy loam about 3 inches thick. The subsurface layer is brown fine sandy loam about 12 inches thick. The subsoil is about 15 inches thick. The upper part is reddish brown, friable very gravelly sandy loam, and the lower part is brown, loose very gravelly sand. The substratum to a depth of about 60 inches is brown very gravelly coarse sand. In places the upper part of the soil is sand or loamy sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Banat and Solona and poorly drained Ensley and Minocqua soils in depressions, in drainageways, and on foot slopes. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate or moderately rapid in the upper part of the Pemene soil and moderately rapid in the lower part. It is moderate in the upper part of the Nadeau soil and very rapid in the lower part. The available water capacity is moderate in the Pemene soil and very low in the Nadeau soil. Surface runoff is slow on both soils.

Most areas of these soils are used as woodland. The major concerns in managing woodland are seedling mortality, plant competition, and the windthrow hazard. The equipment limitation is moderate on landing sites. The best sites for landings are the nearly level included areas. Because of droughtiness, seedling losses may be as high as 25 to 50 percent. Planting when the soils are moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate.

Because of a high content of pebbles and cobbles, the trees on the Nadeau soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not isolate the remaining trees. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control erosion, maintain the organic matter content, and reduce droughtiness. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are well suited to pasture. The main concern in managing pastured areas is conserving moisture during dry periods, when the amount of

moisture is insufficient for optimum plant growth. Rotation grazing or strip grazing and restricted use during dry periods help to keep the pasture in good condition.

The woodland ordination symbols are 4S and 2S, the land capability classification is IIIe, and the Michigan management groups are 4a and 3/5a. The primary habitat type is AQVib, and the secondary type is TMV.

62B—Summerville-Cunard fine sandy loams, 0 to 6 percent slopes. These nearly level and undulating, well drained soils are on upland plains. The Summerville soil is shallow, and the Cunard soil is moderately deep. Individual areas are irregularly shaped and range from 10 to more than 200 acres in size. They are 40 to 65 percent Summerville soil and 20 to 40 percent Cunard soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Summerville soil has a surface layer of very dark grayish brown fine sandy loam about 2 inches thick. The subsoil is friable fine sandy loam about 14 inches thick. The upper part is brown, and the lower part is dark brown. Limestone bedrock is at a depth of about 16 inches. In places the depth to limestone is less than 10 inches.

Typically, the Cunard soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is black fine sandy loam about 4 inches thick. The next 7 inches is mixed brown and dark brown fine sandy loam. The subsoil is about 13 inches thick. The upper part is yellowish red, friable fine sandy loam, and the lower part is reddish brown, friable gravelly fine sandy loam. The substratum is brown gravelly fine sandy loam. Limestone bedrock is at a depth of about 28 inches. In places the depth to limestone is more than 40 inches.

Included with these soils in mapping are small areas of the poorly drained Nahma and somewhat poorly drained Sundell soils in depressions and drainageways and on foot slopes. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the Summerville and Cunard soils, and the available water capacity is low. Surface runoff is slow on the Summerville soil and is moderate on the Cunard soil.

Most areas of these soils are used as woodland. A few are used as cropland or pasture. The major concerns in managing woodland are the windthrow hazard, seedling mortality, and plant competition. The equipment limitation is moderate on logging roads. In some areas the use of equipment may be briefly limited in spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. In some areas the bedrock interferes with road building.

Because of the limited depth to bedrock, the trees on these soils are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Because of droughtiness, seedling losses may be as high as 25 to 50 percent. Planting when the soils are moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

These soils generally are not used as cropland because of the limited depth to bedrock. Overcoming this limitation generally is not practical.

These soils are poorly suited to pasture. The main concern in managing pastured areas is preventing surface compaction. Grazing when the soils are too wet may cause compaction and destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 3D and 3A, the land capability classification is VIs, and the Michigan management groups are Ra and 3/Ra. The primary habitat type is AVO, and the secondary habitat type is ATD.

63B—Bowers-Ingalls complex, 0 to 6 percent slopes. These deep, nearly level and undulating, somewhat poorly drained soils are on upland plains. Individual areas are irregularly shaped and range from 10 to 100 acres in size. They are about 40 to 65 percent Bowers soil and 20 to 40 percent Ingalls soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Bowers soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is light brownish gray silt loam about 1 inch thick. The subsoil is firm silty clay loam about 15 inches thick. The upper part is mixed dark brown and brown, the next part is dark brown and mottled, and the lower part is light brown and mottled. The substratum to a depth of about 60 inches is pink, mottled silty clay loam. In some areas the subsoil contains less clay.

Typically, the Ingalls soil has a surface layer of black fine sand about 3 inches thick. The subsurface layer is grayish brown fine sand about 8 inches thick. The subsoil is mottled fine sand about 14 inches thick. The upper part is dark brown and very friable, the next part is reddish yellow and friable, and the lower part is strong brown and friable. The substratum to a depth of about 60 inches is light reddish brown and light gray, mottled, stratified silt loam and silt. In places the depth to the substratum is less than 20 or more than 40 inches.

Included with these soils in mapping are small areas of the poorly drained Burleigh and Pickford soils in

depressions and drainageways. Also included are small areas of the well drained and moderately well drained Rousseau soils on ridges and knolls. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Bowers soil. It is rapid in the upper part of the Ingalls soil and moderately slow in the lower part. The available water capacity is high in the Bowers soil and moderate in the Ingalls soil. Surface runoff is slow on both soils. From fall through spring, the seasonal high water table is at a depth of 1.0 to 2.0 feet in the Bowers soil and 0.5 foot to 1.5 feet in the Ingalls soil.

Most areas of these soils are used as woodland. The major management concerns are the equipment limitation, the windthrow hazard, and plant competition. The main limitation is the seasonal wetness. If wheeled skidders are used when the soils are wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the soil is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are small areas of the included Rousseau soils, which are better drained than the Bowers and Ingalls soils.

Because of the seasonal wetness, the trees on these soils are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

These soils are well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management concerns are removing excess water and maintaining the organic matter content and tilth. A combination of surface and subsurface drains can lower the seasonal high water table, but locating suitable drainage outlets may be difficult. Unless they are protected, the tile lines can become plugged with sandy material. Additions of organic material and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface are needed on the sandy Ingalls soil. During wet periods, machinery may bog down in the Bowers soil and puddling and crusting may occur. Limiting the use of equipment during wet periods helps to maintain good tilth.

These soils are well suited to pasture. The main management concerns are removing excess water during wet periods and preventing surface compaction. Grazing when the soils are too wet can cause compaction on the Bowers soil and can destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition. Excess water can be removed by surface drains.

The woodland ordination symbols are 7W and 4W, the land capability classification is IIw, and the Michigan soil management groups are 1.5b and 4/2b. The primary habitat type is AVO, and the secondary habitat type is TMC.

64A—Solona-Ingalls complex, 0 to 2 percent slopes. These deep, nearly level, somewhat poorly drained soils are on broad, low flats and in depressions and drainageways. Individual areas are irregularly shaped and range from 10 to 150 acres in size. They are 40 to 65 percent Solona soil and 20 to 40 percent Ingalls soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Solona soil has a surface layer of black loam about 2 inches thick. The subsoil is about 22 inches thick. In sequence downward, it is mixed brown and black, friable loam; brown, friable loam; yellowish red, mottled, friable loam; and brown, mottled, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam. In places it is very gravelly coarse sand.

Typically, the Ingalls soil has a surface layer of black fine sand about 3 inches thick. The subsurface layer is grayish brown fine sand about 8 inches thick. The subsoil is mottled fine sand about 14 inches thick. The upper part is dark brown and very friable, the next part is reddish yellow and friable, and the lower part is strong brown and friable. The substratum to a depth of about 60 inches is light reddish brown and light gray, mottled, stratified silt loam and silt. In places the depth to the substratum is less than 20 or more than 40 inches. In some areas the substratum is gravelly fine sandy loam.

Included with these soils in mapping are small areas of the poorly drained Burleigh and Ensley soils in depressions and drainageways. Also included are small areas of the well drained Onaway soils on ridges and knolls. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Solona soil. It is rapid in the upper part of the Ingalls soil and moderately slow in the lower part. The available water capacity is moderate in both soils. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. The main limitation is the seasonal wetness. If wheeled skidders are used when the soils are wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites

for year-round logging roads, fill, gravel, and culverts are needed. The best landing sites are the included areas of well drained Onaway soils.

Because of the seasonal wetness, the trees on these soils are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

These soils are well suited to such crops such as oats, barley, corn, and a mixture of grasses and legumes. The main management concerns are removing excess water and maintaining the organic matter content and tilth. A combination of surface and subsurface drains can lower the seasonal high water table, but locating drainage outlets may be difficult. Unless they are protected, the tile lines can become plugged with sandy material. Additions of organic material and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface are needed on the sandy Ingalls soil. During wet periods, machinery may bog down in the loamy Solona soil and puddling and crusting may occur. Limiting the use of equipment during wet periods helps to maintain good tilth.

These soils are well suited to pasture. The main management concerns are removing excess water during wet periods and preventing surface compaction. Grazing when the soils are too wet can cause compaction in the loamy areas and can destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition. Excess water can be removed by surface drains.

The woodland ordination symbols are 3W and 4W, the land capability classification is IIw, and the Michigan soil management groups are 3b and 4/2b. The primary habitat is TMC, and the secondary habitat type is TM.

66B—Johnswood-Detour complex, 2 to 6 percent slopes, very stony. These deep, undulating soils are on broad ridges in the uplands. The Johnswood soil is moderately well drained, and the Detour soil is somewhat poorly drained. Flat stones are on the surface. They are 15 to 25 inches long and are 1 to 3 feet apart. Individual areas are irregularly shaped and range from 10 to 250 acres in size. They are 35 to 55 percent Johnswood soil and 35 to 45 percent Detour soil. The two soils occur in areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Johnswood soil has a surface layer of black cobbly loam about 2 inches thick. The next layer is mixed black and dark brown cobbly loam about 3 inches thick. The subsoil is about 11 inches thick. The upper part is dark brown, friable cobbly loam, and the lower part is dark reddish brown, mottled, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam.

Typically, the Detour soil has a surface layer of black cobbly loam about 5 inches thick. The subsoil is mottled, friable fine sandy loam about 14 inches thick. The upper part is dark brown, and the lower part is brown. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam. In places it is very gravelly sand.

Included with these soils in mapping are small areas of the poorly drained Ensley and Minocqua soils on foot slopes and in depressions. Also included are small areas of the well drained Nadeau and Onaway soils on ridges and knolls. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Johnswood and Detour soils, and the available water capacity is moderate. Surface runoff is slow. From fall through spring, the seasonal high water table is at a depth of 2.5 to 6.0 feet in the Johnswood soil and 0.5 foot to 2.0 feet in the Detour soil.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, seedling mortality, and plant competition are management concerns. The main limitation is the seasonal wetness. During wet periods, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. In some areas large surface stones reduce the operating speed of skidders. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed.

Because of the wetness, a firm substratum, and the high content of cobbles and stones, the trees on these soils are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Because of the high content of stones, cobbles, and pebbles in the surface layer, seedling losses may exceed 25 percent in some areas. After trees are cut, plant competition can delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants. If trees are planted, site preparation by mechanical or chemical means generally is needed to control the competing plants.

These soils are unsuitable as cropland, mainly because of the stoniness and the seasonal high water table. Overcoming these limitations generally is not practical.

These soils are poorly suited to pasture. The main management concerns are surface compaction and stoniness. Grazing when the soils are too wet can cause

compaction and destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 3F and 7W, the land capability classification is VIs, and the Michigan soil management groups are Ga and 3b. The primary habitat type is AVO, and the secondary habitat type is TM.

67B—Pemene fine sandy loam, 3 to 12 percent slopes. This deep, undulating and gently rolling, well drained soil is on ridges and knolls in the uplands. Individual areas are irregularly shaped and range from 5 to 250 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 6 inches thick. The next layer is mixed brown and reddish brown, friable fine sandy loam about 6 inches thick. The subsoil is reddish brown, friable fine sandy loam about 16 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Ensley and somewhat poorly drained Solona soils in depressions and on foot slopes. Also included are small areas of the well drained Nadeau soils. These soils are intermingled with areas of the Pemene soil. They have more sand and pebbles in the substratum than the Pemene soil. Included soils make up about 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Pemene soil. Surface runoff is slow.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. The major concerns in managing woodland are plant competition and seedling mortality. The equipment limitation is moderate on landing sites. In some areas the use of equipment may be briefly limited in the spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily. The best sites for landings are the nearly level included areas. When openings are made in the canopy, invading plants can prevent or delay reforestation. Plant competition can be controlled by mechanical or chemical means. Because of droughtiness, seedling losses may be as high as 25 to 50 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate.

This soil is fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion, conserve moisture, and maintain the organic matter content. Examples are crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. The main management concerns are controlling erosion and conserving moisture. Maintaining adequate plant cover helps to control runoff and erosion. Rotation grazing or strip grazing helps to keep the pasture in good condition during dry periods.

The woodland ordination symbol is 4S, the land capability classification is IIIe, and the Michigan soil management group is 3a. The primary habitat type is AQVib, and the secondary habitat type is TMV.

67D—Pemene fine sandy loam, 15 to 35 percent slopes. This deep, rolling to steep, well drained soil is on ridges, hills, and side slopes in the uplands. Individual areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 6 inches thick. The next layer is mixed brown and reddish brown, friable fine sandy loam about 6 inches thick. The subsoil is reddish brown, friable fine sandy loam about 16 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Ensley and somewhat poorly drained Solona soils on foot slopes. Also included are small areas of the well drained Nadeau soils. These soils are intermingled with areas of the Pemene soil. They have more sand and pebbles in the substratum than the Pemene soil. Included soils make up about 10 percent of the unit.

Permeability and the available water capacity are moderate in the Pemene soil. Surface runoff is rapid.

Most areas of this soil are used as woodland. The equipment limitation, the erosion hazard, seedling mortality, and plant competition are concerns in managing woodland. The slope limits the use of equipment and the number of suitable landing sites. Special care is needed in laying out logging roads and operating equipment. The roads should be designed so that they conform to the topography and should be built on the contour as much as possible. The use of equipment may be briefly limited in spring and in other excessively wet periods. During these periods, unsurfaced roads are slippery and ruts form easily.

Erosion results from the concentration of runoff on skid trails, on logging roads, and in the tracks of wheeled equipment. It can be minimized by locating logging roads and skid trails on gentle grades; by removing water with water bars, out-sloping road surfaces, and culverts; and by seeding skid roads and trails after logging activities are complete.

Because of droughtiness, seedling losses may be as high as 25 to 50 percent on this soil. Planting when the

soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

Crops generally are not grown on this soil because of the slope and a severe hazard of erosion. Overcoming these limitations generally is not practical.

This soil is poorly suited to pasture. The main concern in managing pastured areas is the erosion hazard. Measures that prevent overgrazing help to maintain an adequate plant cover and thus help to control runoff and erosion.

The woodland ordination symbol is 4R, the land capability classification is VIIe, and the Michigan soil management group is 3a. The primary habitat type is AQVib, and the secondary habitat type is TMV.

68B—Cunard-Sundell complex, 0 to 8 percent slopes. These moderately deep soils are on uplands. The nearly level to gently rolling, well drained Cunard soil is on low ridges and knolls. The nearly level, somewhat poorly drained Sundell soil is in depressions and drainageways. Individual areas are irregularly shaped and range from 20 to 150 acres in size. They are 40 to 65 percent Cunard soil and 25 to 40 percent Sundell soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Cunard soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is black fine sandy loam about 4 inches thick. The next layer is mixed brown and dark brown fine sandy loam about 7 inches thick. The subsoil is about 13 inches thick. The upper part is yellowish red, friable fine sandy loam, and the lower part is reddish brown, friable gravelly fine sandy loam. The substratum is brown gravelly fine sandy loam. Limestone bedrock is at a depth of about 28 inches. In places the depth to limestone is less than 20 or more than 40 inches.

Typically, the Sundell soil has about 2 inches of undecomposed forest litter at the surface. The surface layer is black loam about 7 inches thick. The subsoil is about 11 inches thick. The upper part is mixed dark brown and very dark gray, friable loam, and the lower part is brown, mottled, friable fine sandy loam. The substratum is fine sandy loam. It is brownish yellow and mottled in the upper part and yellowish red in the lower part. Limestone bedrock is at a depth of about 23 inches. In places the depth to limestone is more than 40 or less than 20 inches.

Included with these soils in mapping are small areas of the poorly drained Nahma soils in depressions. Also included are small areas of the deep, well drained Nadeau and Posen soils, which are in landscape positions similar to those of the Cunard soil. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Cunard and Sundell soils, and the available water capacity is low. Surface runoff is medium on the Cunard soil and slow on the Sundell soil. The Sundell soil has a seasonal high water table at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. The main limitation is the seasonal wetness of the Sundell soil. If wheeled skidders are used when the soils are wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. On sites for year-round logging roads, fill, gravel, and culverts are needed. In a few areas the bedrock interferes with road building. The best landing sites are the nearly level areas of the Cunard soil.

Because of the wetness, the trees on the Sundell soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay regeneration. Plant competition can be controlled by mechanical or chemical means.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion, remove excess water from low areas, and maintain good tilth. Erosion can be controlled by cover crops, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. Surface drains can remove surface water, but locating drainage outlets may be difficult. Erosion-control structures may be needed where surface ditches enter drainageways. When the low areas are wet, machinery may bog down and puddling and crusting may occur. Limiting the use of equipment during wet periods helps to maintain good tilth.

These soils are well suited to pasture. The main management concern is surface compaction. Grazing when the soils are too wet can cause compaction and destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 3A and 2W, the land capability classification is IIIe, and the Michigan soil management groups are 3/Ra and 3/Rbc. The primary habitat type is TM, and the secondary habitat type is ATD.

69B—Onaway-Rousseau-Solona complex, 0 to 12 percent slopes. These deep soils are on uplands. The nearly level to gently rolling, well drained Onaway and Rousseau soils are on ridges and knolls. The nearly level

and undulating, somewhat poorly drained Solona soil is in depressions and drainageways. Individual areas are irregularly shaped and range from 20 to 150 acres in size. They are 30 to 50 percent Onaway soil, 20 to 30 percent Rousseau soil, and 20 to 35 percent Solona soil. The three soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Onaway soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is dark brown fine sandy loam about 1 inch thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish red, friable loam. The substratum to a depth of about 60 inches is light yellowish brown and brown gravelly fine sandy loam. In places the depth to the substratum is less than 15 or more than 30 inches. In some areas the lower part of the subsoil has less clay.

Typically, the Rousseau soil has about 1 inch of black, well decomposed forest litter at the surface. The surface layer is black fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is fine sand about 23 inches thick. The upper part is dark brown and very friable, and the lower part is strong brown and is very friable and loose. The substratum to a depth of about 60 inches is pink fine sand. In some areas the lower part of the subsoil and the substratum are loamy.

Typically, the Solona soil has a surface layer of black loam about 2 inches thick. The subsoil is about 22 inches thick. In sequence downward, it is mixed black and brown, friable loam; brown, friable loam; yellowish red, mottled, friable loam; and brown, mottled, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is light brown, mottled gravelly fine sandy loam.

Included with these soils in mapping are small areas of the somewhat poorly drained Ingalls and Wainola soils. These included soils are in landscape positions similar to those of the Solona soil. Also included are small areas of the poorly drained Deford soils in the lower landscape positions. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Onaway and Solona soils and rapid in the Rousseau soil. The available water capacity is low in the Rousseau soil and moderate in the Onaway and Solona soils. Surface runoff is medium on the Onaway soil and slow on the Rousseau and Solona soils. The Solona soil has a seasonal high water table at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas of these soils are used as woodland. The equipment limitation, the windthrow hazard, seedling mortality, and plant competition are management concerns. The main limitation is the seasonal wetness of the Solona soil. If wheeled skidders are used when this soil is wet, logging roads tend to be slippery and ruts form easily. Deep ruts tend to restrict lateral drainage and can result in damage to tree roots and alteration of soil structure. Equipment should be used only when the ground is dry or frozen. In areas of the Rousseau soil, loose sand can interfere with the traction of wheeled equipment during dry periods. On sites for year-round logging roads, a gravel base is needed. The best landing sites are the nearly level areas of the Onaway and Rousseau soils.

Because of the seasonal wetness, the trees on the Solona soil are shallow rooted. Some may be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Because of droughtiness in the sandy Rousseau soil, seedling losses may exceed 25 percent. Planting when the soil is moist can reduce these losses. Containerized seedlings or special planting stock also can reduce the seedling mortality rate. When openings are made in the canopy, invading plants can prevent or delay regeneration. Plant competition can be controlled by chemical or mechanical means.

These soils are fairly well suited to such crops as oats, barley, corn, and a mixture of grasses and legumes. The main management needs are measures that control water erosion and soil blowing, conserve moisture during dry periods, and remove excess water from low areas. Erosion can be controlled by crop rotations that include grasses and legumes, cover crops, crop residue management, grassed waterways, contour stripcropping, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. Buffer strips, field windbreaks, and conservation tillage help to control soil blowing on the sandy Rousseau soil. A combination of surface and subsurface drains can lower the seasonal high water table, but locating suitable drainage outlets may be difficult. Erosion-control structures may be needed where surface ditches enter drainageways.

These soils are well suited to pasture. The main management concern is preventing surface compaction. Grazing when the Solona soil is too wet can cause compaction and destroy forage plants. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

The woodland ordination symbols are 3A, 5S, and 3W; the land capability classification is IIIe; and the Michigan soil management groups are 3a, 5.3a, and 3b. The primary habitat type is TM, and the secondary habitat type is TMV.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S.

Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 190,000 acres in the survey area, or more than 28 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the central part, mainly in map units 3, 4, and 7, which are described under the heading "General Soil Map Units."

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 8. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 7. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 8. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, foresters, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

Dwight L. Quisenberry, agronomist, and Gary Rinkenberger, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained (*11*); and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1982, approximately 90,200 acres in Menominee County was used for crops and pasture (*14*). Of this total, about 27,000 acres was used for hay, 18,700 acres for corn, and 11,000 acres for small grain. The rest was pastured.

Dairying and beef farming are of major importance in the county. Dairy farms range from 40 to 700 acres in size. In 1983, about 8,500 dairy cows produced 103,800,000 pounds of milk, making Menominee County the leader in dairy production in the Upper Peninsula of Michigan (*5*).

The field crops commonly grown in the county are alfalfa, corn, oats, and barley. Alfalfa hay is used mainly as livestock feed.

Specialty crops are of limited commercial importance in the county. They include small acreages of raspberries, strawberries, cabbage, and potatoes and some apple orchards.

Cropland

Crop production in the county could be increased by applying measures that conserve soil and water and by extending the latest crop production technology to all of the cropland in the county. The paragraphs that follow describe the main concerns in managing the cropland in the county.

Water erosion is a major hazard on some of the loamy soils that have a slope of more than 3 percent. Examples are Cunard, Nadeau, and Onaway soils. The loss of the surface layer through erosion results in

reduced productivity. As the surface layer erodes, nutrients and organic matter are lost and part of the subsoil is incorporated into the plow layer. The subsoil material, which dominantly has a high pH and a low natural fertility level, can restrict seed germination and the availability of nutrients. Exposure of the subsoil can increase the hazard of erosion.

Water erosion can result in clogged tile drains and sedimentation of creeks and waterways. Sediment that contains fertilizer and pesticides can reduce the quality of water. Controlling erosion reduces the runoff rate, increases the rate of water infiltration, and minimizes the loss of organic matter and the amount of sediment that enters waterways.

A system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and reduces the hazards of runoff and erosion. No-till cropping systems require high levels of management. Herbicides and insecticides are used to control weeds, insects, and pests. No-till farming is especially effective in minimizing erosion on the lighter colored, sloping soils in the county.

Contour stripcropping is effective in controlling erosion. It is best suited to deep, well drained, sloping soils that are highly susceptible to erosion. Onaway soils are an example. Contour stripcropping alternates strips of row crops with strips of small grain or hay. It is used on about 8,000 acres in the county.

Grassed waterways are used on undulating and gently rolling soils. They help to control channel erosion on sloping soils. They also stabilize areas that are already eroded. Subsurface drains are installed underneath the waterways to remove excess internal water. Removing this water enhances the growth of plants and facilitates the use of machinery.

Soil blowing is a hazard on Rousseau, Mancelona, and Rubicon soils and on organic soils that are drained. It can be controlled by maintaining a cover of vegetation or mulch, alternating strips of row crops with strips of hay, leaving crop residue on the surface, and keeping the surface rough through proper tillage methods. Field windbreaks of adapted trees and shrubs planted at right angles to the prevailing wind also help to control soil blowing.

Wetness is a limitation on some of the cropland in the county. Some areas of the poorly drained Ensley and Minocqua soils can be adequately drained. Other areas of these soils and areas of very poorly drained, organic soils, however, cannot be economically drained. The poorly drained and very poorly drained soils are in low areas and depressions where ponding occurs and where suitable gravity outlets are not readily available. Pumping stations can be used in some areas where a gravity outlet is not available. These soils have low soil temperatures and are subject to extended periods of frost, which hinder seed germination. In areas of Banat, Gladwin, Solona, and other somewhat poorly drained soils, a drainage system is needed. Tillage, seed germination, and plant growth are adversely affected unless excess water is removed from these soils.

Subsurface tile drainage systems are the primary methods of removing excess water. Spacing of tile drains should be based on the permeability of the soils. In some areas open ditches are needed as outlets for the tile drains. Small areas of wetter soils in swales are commonly included with the well drained soils in mapping. Fieldwork is delayed in some of these areas unless a drainage system is installed.

Soil fertility is naturally low in the sandy soils and medium in most of the loamy soils in the county. Onaway, Nadeau, and other soils that have a high content of lime are characterized by manganese, boron, and zinc deficiencies. Additions of fertilizer on all soils should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer to be applied (*6*).

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. The use of machinery on wet soils results in compaction and surface crusting. Preparing a good seedbed in severely eroded soils is difficult. These soils are low in moisture content and are susceptible to surface crusting, which hinders seedling germination. An adequate drainage system, timely fieldwork, conservation tillage, and measures that maintain the content of organic matter improve soil structure, minimize compaction, and help to prevent crusting.

Further information about managing cropland is available at local offices of the Cooperative Extension Service and the Soil Conservation Service.

Pasture

Pasture is important in the county because of the number of dairy and beef enterprises. The most commonly grown pasture species in the county are alfalfa, bromegrass, timothy, and red clover. Much of the permanent pasture is in areas of Onaway and Nadeau soils where erosion can be a hazard. Many other pastures are in areas of Solona and Ensley soils where soil compaction can be a problem.

Measures that prevent overgrazing help to protect the plant cover and thus reduce the hazards of runoff and erosion. Grazing when the soils are wet results in compaction and thus in poor forage production. The productivity of a pasture and its ability to protect the soil are influenced by the number of livestock in the pasture, the length of time that they graze, and the distribution of rainfall. Good pasture management includes proper stocking rates, pasture rotation, and deferred grazing.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 9. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 9 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 10. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table. Also given at the end of each map unit description is a Michigan soil management group (*7*). The soils are assigned to a group according to the need for lime and fertilizer and for artificial drainage and other practices. For soils making up a complex, the management groups are listed in the same order as the series named in the complex.

Woodland

About 496,000 acres in the county, or nearly 75 percent of the total acreage, is woodland. About 91,600 acres, or nearly 14 percent of the total acreage, is

managed by the state. Forest industry companies own and manage about 123,000 acres, or about 18 percent of the total acreage. The remaining 281,400 acres of woodland occurs as privately owned tracts, most of which are small (*16*).

Stands on the upland soils are dominantly northern hardwoods, mainly sugar maple, white ash, and American basswood. Many areas that formerly were severely burned now support aspen or aspen mixed with paper birch. Approximately one-third of the woodland occurs as wetlands, which are dominated by northern white-cedar and support lesser amounts of balsam fir, tamarack, and black spruce. A small area along the Menominee River supports northern red oak, red maple, and jack pine.

Woodland Products

The harvesting, transportation, and processing of wood are mainstays of the economy in Menominee County. Because of the large amount of forested land, the good transportation system, the productive soils, and the proximity to wood-processing industries and urban areas, the future economy of the county will continue to be based mainly on woodland products. Improved woodland management, particularly on small, privately owned tracts, is needed to ensure that the desired types of raw products will be available in sufficient quantity in the future. The most important woodland products in the county are described in the following paragraphs.

Pulpwood.—Menominee County is one of Michigan's leading pulpwood-producing counties. Most of the pulpwood is cut in stands that either have such poor species composition or have trees of such low quality that a regeneration harvest is the most feasible silvicultural practice. The dominant pulpwood species are aspen (fig. 6), spruce, balsam fir, and low-quality mixed hardwoods. Pulpwood production in the county will probably remain important in the future. Many paper mills are within a relatively short distance.

Lumber and pallets.—Most of the sawlogs harvested are the largest and best logs that are sorted out during pulpwood-cutting operations. Very few large stands of sawtimber-sized trees remain. In areas where a few large trees remain in a stand of smaller trees, the large trees are generally of poor quality. Veneer logs are few in number and are shipped out of the county for processing. Several small sawmills throughout the county, however, make lumber out of the best sawlogs. A few local furniture factories utilize the higher grade lumber produced by the local sawmills. The lower quality sawlogs are generally made into low-grade lumber and pallets. The main species used for lumber and pallets are white pine, red pine, sugar maple, white ash, aspen, red maple, and paper birch.

Poles and posts.—The important woodland products in the county include poles and posts. Northern white-cedar, which is abundant, is the preferred species for fences and posts, which are made in several local mills. Straight, pole-sized white and red pine can be made into excellent utility poles. A new market is developing for red pine and cedar poles in the form of logs for home construction. As log homes become increasingly popular, this market should steadily expand.

Fuel wood.—The rising cost of fossil fuels has dramatically increased the demand for wood for

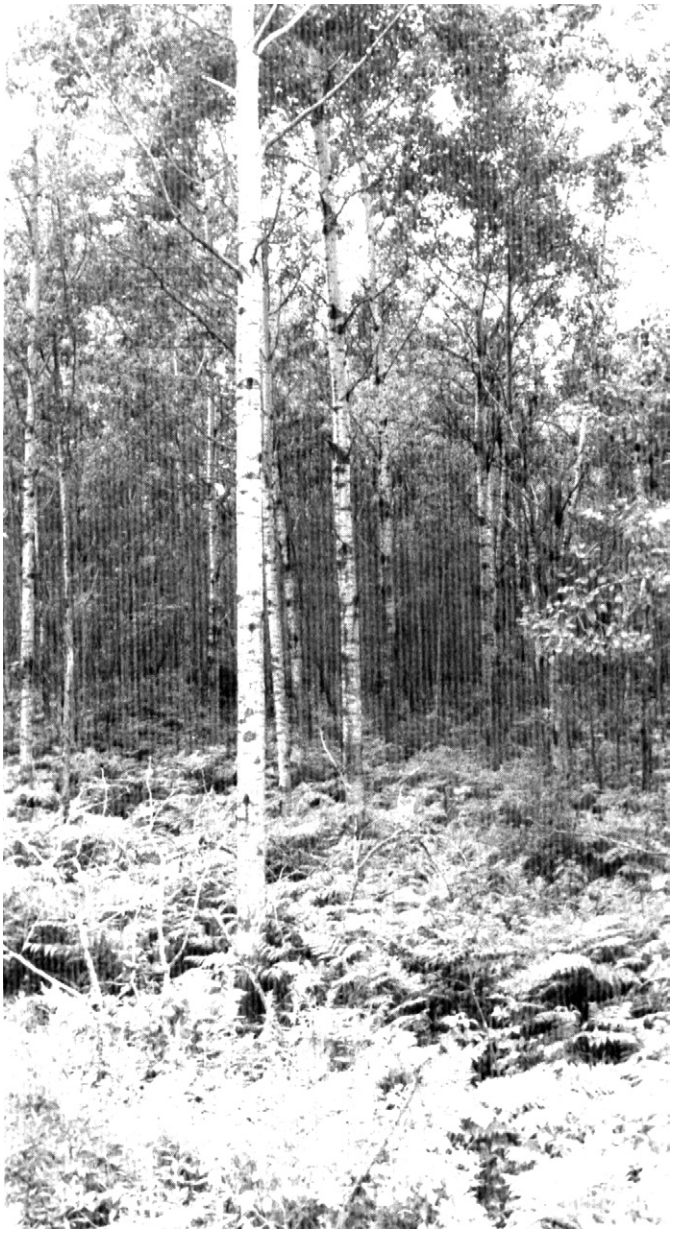

Figure 6.—Stand of aspen used for pulpwood in an area of Pemene-Rubicon complex, 3 to 12 percent slopes.

residential and industrial heating. Removing poor-quality trees and undesirable timber species for fuel wood is an excellent forest management practice. Recently, several schools, industries, and paper companies have adapted their boilers to the use of sawdust and wood chips for heating.

Christmas trees and evergreen brush.—A few individuals in the county currently grow and market Christmas trees (fig. 7). The opportunity to increase the output of this woodland product is great. Planting Christmas trees on abandoned farmland is an excellent method of returning the land to production. The most common species grown for Christmas trees are balsam fir, white spruce, and Scotch pine. There is a local seasonal market for evergreen boughs. Balsam fir boughs are cut in the fall and bought locally. They are made into grave blankets and Christmas wreaths, which are then distributed nationally. One local company purchases and extracts oil from northern white-cedar brush. The oil is used in various cosmetics and pharmaceutical products. Although limited in scope, the sale of evergreen brush is an important source of supplemental income for local residents.

Maple syrup.—Several small enterprises that produce maple syrup are throughout the county. Because of the abundance of mature sugar maple in the uplands, the potential for increased production of maple syrup is good.

Woodland Management and Productivity

Tables 11 and 12 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. Table 11 lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the

Figure 7.—Christmas trees on Onaway fine sandy loam, 3 to 9 percent slopes.

same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 11, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand. The volume was determined through the use of standard yield tables (*15*).

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Table 12 gives information about operating harvesting or thinning equipment in logging areas and on skid trails, landings, and logging roads. Limitations are given for the most limiting season and for the preferred season. The *most limiting season* in Menominee County generally is spring or late fall. In some areas, however, it is during dry periods in summer, when loose sand can limit trafficability on deep, well drained, sandy soils. The *preferred operating season* is the period when harvesting

or thinning causes the least amount of soil damage. This period generally is when the soil is not too wet or when the ground is frozen or partly frozen or has an adequate snow cover.

In table 12 a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high floatation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Logging areas and skid trails include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid trails, which generally are within the logging area, are roads or trails over which logs are dragged or hauled from the stump to a log landing.

Landings are areas where logs are assembled for transportation. Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Logging roads are access roads leading from primary or surfaced roads to the logging areas. The logging roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved roads. Some are graveled.

Forest Habitat Types

The information in this section is derived from a field guide developed for the Upper Peninsula of Michigan and for northeast Wisconsin (*4*). The system of habitat classification used in the guide is based on the concept that plants occur in predictable patterns or communities and that these communities reflect differences in site characteristics.

Besides identifying the various habitat types by means of vegetative keys, the guide also provides information about the different possible successional stages for most of the habitat types. The successional stages depend largely on how the forest has been disturbed. They include the succession after logging in the original climax stands, the succession after logging in second-growth stands, and the succession in stands that have been logged and burned.

The guide gives the suggested forest management for each of the successional stages. This management includes methods of thinning and harvest, site preparation, and measures that improve regeneration of the stands. The potential productivity, in terms of a site index and the mean annual volume in cubic feet per acre per year, is given for most of the habitat types. The development of the descriptive or interpretive information for some of the habitat types, however, is based on limited data and thus should be used with caution.

Habitat types have been determined for each map unit in the survey area. The primary habitat type is the one that is most common on the map unit. The secondary habitat type is less common. Habitat types are specified at the end of the descriptions in the section "Detailed Soil Map Units." They also are specified in the section "Interpretive Groups," which follows the tables at the back of this survey.

The following paragraphs describe the habitat types in the survey area. They provide information about the potential climax species, some of the common understory species, and, if known, the potential productivity of the habitat type.

AQVac—Acer-Quercus-Vaccinium habitat type. This habitat type has a potential climax overstory dominated by red maple and red oak. Other species include eastern hemlock, white spruce, balsam fir, and white spruce. The dominant ground flora includes lowbush blueberry, Canada blueberry, brackenfern, wintergreen, bigleaf aster, and hazelnut. The potential productivity is moderately low for northern hardwoods, moderate for aspen, and moderately high for red pine and jack pine.

AQVib—Acer-Quercus-Viburnum habitat type. This habitat type has a potential climax overstory dominated by red maple and red oak. Other species include American beech, sugar maple, white ash, and American basswood. The dominant ground flora includes mapleleaf viburnum, witchhazel, trefoil tickclover, brackenfern, and hazelnut. The potential productivity is moderately high for northern hardwoods and high for aspen and red pine.

ATD—Acer-Tsuga-Dryopteris habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include eastern hemlock, American basswood, and American beech. Yellow birch, red maple, and American elm are in some areas. The dominant ground flora includes spinulose woodfern, twistedstalk, hairy Solomons-seal, scarlet alder, and Canada mayflower. The potential productivity is moderately high for northern hardwoods and high for aspen. It also is high for red pine plantations if plant competition is controlled.

AVO—Acer-Viola-Osmorhiza habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include American basswood, white ash, yellow birch, eastern hophornbeam, eastern hemlock, and American elm. The dominant ground flora includes smooth yellow violet, Canada white violet, downy yellow violet, sweet cicely, spinulose woodfern, common ladyfern, hairy Solomons-seal, and twistedstalk. The potential productivity is high for northern hardwoods and aspen. It also is high for red pine plantations if plant competition is controlled.

FMC—Fraxinus-Mentha-Carex habitat type. This habitat type has a potential climax overstory dominated by black ash and American elm. Other species include red maple and balsam fir. The dominant ground flora

consists of sedge, field mint, speckled alder, and spotted touchmenot.

PCS—Picea-Chamadaphne-Sphagnum habitat type. This habitat type has a potential climax overstory dominated by black spruce. Other species include tamarack. Northern white-cedar is in some stands. The dominant ground flora consists of leatherleaf, bog rosemary, pale laurel, sphagnum, Labrador tea, sedge, and Canada blueberry.

QAE—Quercus-Acer-Epigaea habitat type. This habitat type has a potential climax overstory dominated by red oak and red maple. White spruce and white pine are in some stands. The dominant ground flora consists of brackenfern, trailing arbutus, wintergreen, lowbush blueberry, mosses, and Canada blueberry. The potential productivity is moderately low for aspen and moderate for red pine and jack pine.

TM—Tsuga-Maianthemum habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock, sugar maple, and red maple. Other species include yellow birch. White spruce, balsam fir, white pine, red oak, northern white-cedar, and American basswood are in some stands. The dominant ground flora includes Canada mayflower, brackenfern, sedge, American starflower, and wild sarsaparilla. The potential productivity is moderate for northern hardwoods, moderately high for aspen, and high for red pine and jack pine.

TMC—Tsuga-Maianthemum-Coptis habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Other species include sugar maple and yellow birch. Balsam fir, white spruce, and northern white-cedar are in some areas. The dominant ground flora consists of Canada mayflower, goldthread, yellow beadlily, bunchberry dogwood, American starflower, and spinulose woodfern. The potential productivity is moderate for northern hardwoods.

TMV—Tsuga-Maianthemum-Vaccinium habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Other species include sugar maple, white pine, balsam fir, and white spruce. Red oak is in some areas. The dominant ground flora includes Canada blueberry, wild sarsaparilla, brackenfern, Canada mayflower, lowbush blueberry, yellow beadlily, and wood betony. The potential productivity is moderate for northern hardwoods, moderately high for aspen, and high for red pine and jack pine.

TTM—Tsuga-Thuja-Mitella habitat type. This habitat type has a potential climax overstory dominated by northern white-cedar. Other species include balsam fir and red maple. The dominant ground flora consists of naked miterwort, sedge, Canada mayflower, American starflower, twinflower, and bunchberry dogwood.

TTS—Tsuga-Thuja-Sphagnum habitat type. This habitat type has a potential climax overstory dominated by northern white-cedar. Other species include balsam fir and black spruce. Red maple is in some stands. The dominant ground flora includes sphagnum, goldthread, bunchberry dogwood, sedge, Canada mayflower, American starflower, and wood sorrel.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 13 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 13 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

The soils of the survey area are rated in table 14 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 14, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 14 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 17 and interpretations for dwellings without basements and for local roads and streets in table 16.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 15, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are partridgeberry, goldenrod, strawberry, and red fescue.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone,

available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, beech, dogwood, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are nannyberry, silky dogwood, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, and cedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are arrowhead, wild millet, wildrice, cattail, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobolink, pheasant, meadowlark, hawks, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, snowshoe hare, woodpeckers, squirrels, porcupine, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations (*13*). Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 16 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 17 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 17 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if

slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 17 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 17 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 18 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable

material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 18, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 19 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content

of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

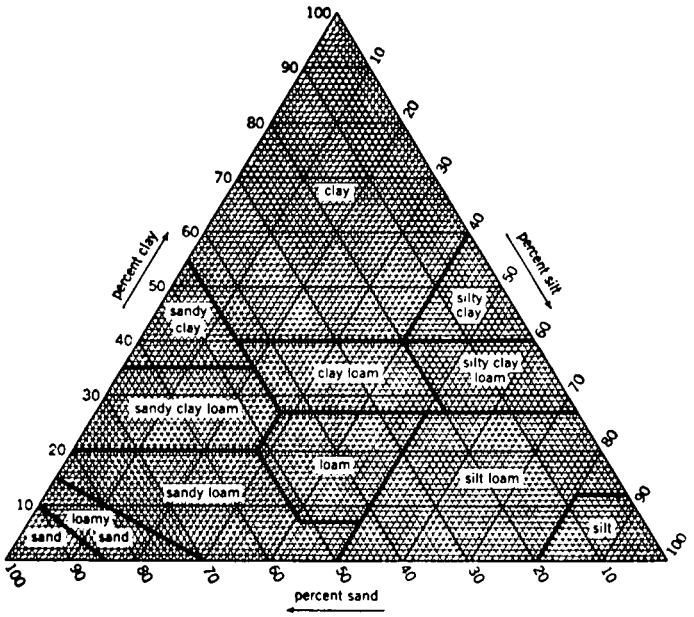

Figure 8.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 20 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 8). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of

grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 21 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to

buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing erosion are used.
6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 21, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 22 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 22, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 22 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 21 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 21.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Characterization Data for Selected Soils

Many of the soils in Menominee County were sampled for physical and chemical analyses by the Soil Research Laboratory, Ford Forestry Center, Michigan Technological University, L'Anse, Michigan (*9*). The laboratory data obtained from the soil samples includes analyses of particle-size distribution, coarse fragments, bulk density, and moisture retention. Complete chemical analyses were also performed on each sample, and

spodic horizon criteria were determined on the appropriate samples. Standard National Cooperative Soil Survey procedures were used for all analyses. Forest sites also were sampled for an estimate of the productivity of many of the soils for wood products.

These data were used in classifying and correlating the soils and in evaluating their behavior, especially under forestry uses. Many profiles were selected as representative of their respective series. These series and their laboratory identification numbers are as follows: Banat (S81MI-109-2), Cunard (S81MI-109-3), Deford (S79MI-109-5), Ensign (S82MI-109-4), Grayling (S80MI-109-1), Nadeau (S79MI-109-2), Onaway taxadjuncts (S79MI-109-3 and S80MI-109-3), Onaway (S79MI-109-4), Pemene (S80MI-109-2), Rousseau (S80MI-109-7), Rubicon (S79MI-109-1), a Solona taxadjunct (S81MI-109-1), Sundell (S81MI-109-4), Summerville (S80MI-109-6), and Wainola (S80MI-109-4).

In addition to the Menominee County data, soil characterization data and forest site data are available from nearby counties having many of the same soils that were not sampled in Menominee County. These data and the Menominee County data are available at the Soil Research Laboratory, Ford Forestry Center, Michigan Technological University, L'Anse, Michigan; the Environmental Division, Michigan Department of Agriculture, Lansing, Michigan; and the Soil Conservation Service, State Office, East Lansing, Michigan.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*12*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 23 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boralf (*Bor*, meaning cool, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Eutroboralf (*Eutro*, meaning high base saturation, plus *boralf*, the suborder of the Alfisols that has a frigid soil temperature class).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Eutroboralfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed Typic Eutroboralfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*10*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*12*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Amasa Series

The Amasa series consists of deep, moderately well drained soils on outwash plains and terraces. These soils formed in loamy and sandy glaciofluvial deposits. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope is 0 to 3 percent.

The Amasa soils in this survey area are lighter colored in the subsoil than is definitive for the series. This difference, however, does not alter the usefulness of the soils.

Amasa soils are commonly adjacent to Arnheim, Grayling, and Lupton soils. Arnheim soils are poorly

drained and are lower on the landscape than the Amasa soils. They irregularly decrease in the content of organic matter with increasing depth. Grayling soils are sandy throughout. They are higher on the landscape than the Amasa soils. Lupton soils are organic. They are lower on the landscape than the Amasa soils.

Typical pedon of Amasa very fine sandy loam, 0 to 3 percent slopes, 2,400 feet south and 1,000 feet east of the northwest corner of sec. 8, T. 34 N., R. 28 W., Lake Township:

A—0 to 1 inch; black (N 2/0) very fine sandy loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; friable; many fine and medium roots; very strongly acid; abrupt wavy boundary.
E—1 to 3 inches; brown (7.5YR 5/2) very fine sandy loam; weak thin platy structure parting to moderate fine granular; friable; many fine and medium roots; very strongly acid; clear wavy boundary.
Bs1—3 to 11 inches; yellowish red (5YR 4/6) very fine sandy loam; moderate fine subangular blocky structure; friable; common fine and medium roots; strongly acid; clear wavy boundary.
Bs2—11 to 18 inches; strong brown (7.5YR 5/6) very fine sandy loam; moderate fine subangular blocky structure; friable; common fine and medium roots; strongly acid; clear wavy boundary.
BC—18 to 31 inches; brown (7.5YR 5/4) loamy sand; common fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very friable; few fine and medium roots; about 2 percent pebbles; strongly acid; clear wavy boundary.
2C—31 to 60 inches; reddish yellow (7.5YR 6/6) sand; common medium prominent yellowish red (5YR 5/8) mottles; single grain; loose; about 2 percent pebbles; medium acid.

The solum ranges from 20 to 35 inches in thickness. The content of pebbles is 0 to 5 percent in the solum.

The A horizon is dominantly very fine sandy loam, but the range includes fine sandy loam. Cultivated areas have an Ap horizon, which is 5 to 9 inches thick. The E and Bs horizons are very fine sandy loam or fine sandy loam. The E horizon has value of 4 or 5. The Bs horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The 2C horizon has value of 5 or 6 and chroma of 4 to 6. It is sand, coarse sand, or gravelly coarse sand.

Arnheim Series

The Arnheim series consists of deep, poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Arnheim soils are commonly adjacent to Amasa, Moquah, Nadeau, and Rubicon soils. The adjacent soils are higher on the landscape than the Arnheim soils. Amasa soils are moderately well drained and have a spodic horizon. Moquah soils are moderately well drained and have brighter mottles in the substratum than the Arnheim soils. Nadeau soils are well drained and have a very gravelly coarse sand substratum. Rubicon soils are excessively drained.

Typical pedon of Arnheim mucky silt loam, in an area of Arnheim-Moquah complex, 0 to 3 percent slopes, 2,100 feet east and 1,400 feet north of the southwest corner of sec. 7, T. 35 N., R. 28 W., Lake Township:

Oa—0 to 4 inches; black (5YR 2/1), well decomposed organic material, very dark gray (5YR 3/1) dry; moderate fine granular structure; very friable; many very fine to medium roots; medium acid; abrupt smooth boundary.
C—4 to 16 inches; reddish brown (5YR 4/4) silt loam; many medium prominent very dark gray (N 3/0) mottles; weak fine and medium subangular blocky structure; friable; few fine roots; slightly acid; clear wavy boundary.
Cg—16 to 31 inches; dark gray (N 4/0) silt loam; many medium prominent yellowish red (5YR 5/8) mottles; massive; friable; thin lenses of very fine sand; neutral; clear wavy boundary.
C'1—31 to 35 inches; stratified dark brown (7.5YR 3/2) very fine sand and very dark gray (10YR 3/1) silt loam; common fine faint dark brown (7.5YR 4/2) mottles; massive and friable silt loam; single grain and loose very fine sand; mildly alkaline; clear wavy boundary.
C'2—35 to 43 inches; dark brown (10YR 4/3) fine sand; single grain; loose; mildly alkaline; clear wavy boundary.
C'3—43 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; moderately alkaline.

The color, arrangement, and thickness of the horizons vary considerably because of the nature of the parent material. The Oa horizon has hue of 5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. Some pedons have an A horizon. The C horizon has hue of 10YR, 7.5YR, or 5YR or is neutral in hue. It has value of 3 to 5 and chroma of 0 to 6. It is silt loam, fine sandy loam, very fine sand, fine sand, sand, or coarse sand.

Banat Series

The Banat series consists of deep, somewhat poorly drained soils on outwash plains and stream terraces. These soils formed in loamy material and in stratified, calcareous, gravelly and sandy material. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope is 0 to 3 percent.

Banat soils are similar to Solona soils and are commonly adjacent to Minocqua, Nadeau, and Tawas soils. Solona soils have more silt and clay in the

substratum than the Banat soils. The poorly drained Minocqua and very poorly drained Tawas soils are lower on the landscape than the Banat soils. Tawas soils formed in organic material 16 to 50 inches deep over sandy material. The well drained Nadeau soils are higher on the landscape than the Banat soils.

Typical pedon of Banat silt loam, 0 to 3 percent slopes, 2,150 feet west and 2,400 feet north of the southeast corner of sec. 19, T. 36 W., R. 25 W., Cedarville Township:

Oa—0 to 3 inches; black (10YR 2/1), well decomposed organic material; moderate fine granular structure;, friable; many fine and very fine roots; medium acid; clear wavy boundary.

A—3 to 6 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; strong fine granular structure; friable; many coarse to very fine roots; slightly acid; clear wavy boundary.

E/B—6 to 9 inches; brown (7.5YR 5/2) silt loam; about 30 percent fine prominent pockets of black (10YR 2/1) material from the A horizon and distinct pockets of strong brown (7.5YR 5/6) material from the B horizon; weak medium subangular blocky structure parting to weak thin platy; friable; few coarse and medium and common fine roots; about 7 percent pebbles; neutral; clear broken boundary.

Bt1—9 to 12 inches; dark brown (7.5YR 4/4) loam; common medium faint strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few medium and fine roots; common faint and distinct clay films on faces of peds; about 10 percent pebbles; mildly alkaline; abrupt wavy boundary.

2Bt2—12 to 16 inches; strong brown (7.5YR 5/6) very gravelly sandy loam; few medium faint strong brown (7.5YR 5/6) and few fine distinct brown (7.5YR 5/2) mottles; weak medium subangular blocky structure; friable; few faint clay films on faces of peds and common faint clay bridges between sand grains; about 51 percent pebbles; mildly alkaline; gradual wavy boundary.

2Bt3—16 to 25 inches; strong brown (7.5YR 5/6) extremely gravelly loamy coarse sand; few medium distinct yellowish red (5YR 5/6) and faint brown (7.5YR 5/4) mottles; single grain; loose; few faint clay bridges between sand grains and few faint clay coatings and stains around sand grains; about 63 percent pebbles and 10 percent cobbles; strong effervescence; mildly alkaline; gradual wavy boundary.

2C—25 to 60 inches; strong brown (7.5YR 5/8) extremely gravelly coarse sand; single grain; loose; about 64 percent pebbles and 10 percent cobbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates typically are 15 to 30 inches but range from 10 to 40 inches. The content of pebbles ranges from 0 to 15 percent in the A, E, and Bt1 horizons and from 35 to 80 percent in the 2Bt2 and 2Bt3 horizons. The content of cobbles more than 3 inches in diameter is 0 to 5 percent in the A, E, and Bt1 horizons and from 0 to 10 percent in the 2Bt2, 2Bt3, and 2C horizons.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is typically silt loam, but the range includes loam and fine sandy loam. Cultivated areas have an Ap horizon. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Its textures are similar to those of the A horizon. The B horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is loam, fine sandy loam, sandy loam, or the gravelly analogs of these textures. The 2Bt2 horizon has colors similar to those of the Bt horizon. It is typically very gravelly sandy loam, but the range includes very gravelly loam and very gravelly fine sandy loam. The 2Bt3 horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. It is very gravelly or extremely gravelly loamy coarse sand or very gravelly loamy sand. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. It is very gravelly or extremely gravelly coarse sand or coarse sand.

Bowers Series

The Bowers series consists of deep, somewhat poorly drained, moderately slowly permeable soils on lake plains. These soils formed in loamy lacustrine deposits. Slope ranges from 0 to 6 percent.

Bowers soils are commonly adjacent to Ingalls, Pickford, and Wainola soils. Ingalls and Wainola soils have a sandy solum. They are in landscape positions similar to those of the Bowers soils. Pickford soils are poorly drained and are lower on the landscape than the Bowers soils.

Typical pedon of Bowers silt loam, in an area of Bowers-Ingalls complex, 0 to 6 percent slopes, 80 feet north and 1,400 feet west of the southeast corner of sec. 10, T. 35 N., R. 25 W., Cedarville Township:

A—0 to 3 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

E—3 to 4 inches; light brownish gray (10YR 6/2) silt loam; moderate fine subangular blocky structure; friable; common fine and medium roots; slightly acid; abrupt wavy boundary.

B/E—4 to 8 inches; dark brown (7.5YR 4/4) silty clay loam (Bt) and brown (7.5YR 5/4) silty clay loam (E); moderate medium subangular blocky structure; firm; few fine and medium roots; slightly acid; clear wavy boundary.

Bt—8 to 15 inches; dark brown (7.5YR 4/4) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; common distinct brown (7.5YR 4/2) clay films on faces of peds; few fine roots; neutral; clear irregular boundary.

BC—15 to 19 inches; light brown (7.5YR 6/4) silty clay loam; few fine distinct reddish yellow (7.5YR 6/8) mottles; massive; firm; few fine roots; moderately alkaline; violent effervescence; gradual broken boundary.

C—19 to 60 inches; pink (7.5YR 7/4) silty clay loam; few fine distinct pinkish gray (7.5YR 6/2) and reddish yellow (7.5YR 6/8) mottles; massive; firm; violent effervescence; moderately alkaline.

The solum ranges from 18 to 28 inches in thickness. The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 5 or 6 and chroma of 2 to 4. The A and E horizons are dominantly silt loam, but the range includes loam. The Bt horizon has hue of 5YR or 7.5YR. It is silty clay loam or clay loam. The C horizon has hue of 5YR or 7.5YR, value of 5 to 7, and chroma of 3 or 4. It is silty clay loam or silt loam.

Burleigh Series

The Burleigh series consists of deep, poorly drained soils on lake plains and moraines. These soils formed in sandy glaciofluvial sediments overlying calcareous, silty lacustrine deposits. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slope is 0 to 2 percent.

The Burleigh soils in this survey area have a higher content of carbonates than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Burleigh soils are commonly adjacent to Deford, Ingalls, Pickford, and Rousseau soils. Deford and Pickford soils are in landscape positions similar to those of the Burleigh soils. Deford soils are sandy in the lower part of the C horizon. Pickford soils have more clay throughout than the Burleigh soils. Ingalls soils are somewhat poorly drained and are in the slightly higher positions on the landscape. Rousseau soils are well drained or moderately well drained and are higher on the landscape than the Burleigh soils.

Typical pedon of Burleigh mucky fine sand, 400 feet east of the southwest corner of sec. 32, T. 33 N., R. 26 W., Menominee Township:

Oa—0 to 4 inches; black (N 2/0) muck; weak fine subangular blocky structure; very friable; many very fine, fine, and coarse roots; neutral; abrupt smooth boundary.

C1—4 to 8 inches; pale brown (10YR 6/3) fine sand; loose; single grain; common very fine and few fine roots; black (10YR 2/1) organic stains along root channels; neutral; gradual wavy boundary.

C2—8 to 20 inches; brown (10YR 5/3) fine sand; loose; single grain; about 5 percent pebbles; strong effervescence; mildly alkaline; gradual wavy boundary.

C3—20 to 30 inches; brown (10YR 5/3) fine sand; loose; single grain; about 2 percent pebbles; strong effervescence; mildly alkaline; abrupt wavy boundary.

2C4—30 to 45 inches; yellowish brown (10YR 5/4) stratified silt loam and very fine sand; common medium faint yellowish brown (10YR 5/6) and common fine distinct light brownish gray (10YR 6/2) mottles; massive; firm; strong effervescence; mildly alkaline; diffuse wavy boundary.

2C5—45 to 60 inches; brown (10YR 5/3) silt loam; common medium faint yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; massive; firm; strong effervescence; mildly alkaline.

The depth to the 2C horizon ranges from 20 to 40 inches. The Oa horizon is neutral in hue or has hue of 7.5YR or 10YR. It has value of 2 or 3 and chroma of 0 to 2. Some pedons have an A horizon. The C horizon has value of 4 to 6 and chroma of 2 or 3. It is sand, fine sand, or loamy sand. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 4.

Cathro Series

The Cathro series consists of deep, very poorly drained, organic soils in depressional areas on lake plains and moraines. These soils formed in decomposed woody material 16 to 50 inches deep over loamy material. Permeability is moderately slow to moderately rapid in the organic material and moderate or moderately slow in the loamy material. Slope is 0 to 2 percent.

Cathro soils are similar to Lupton and Tawas soils and are commonly adjacent to Ensley, Lupton, and Onaway soils. Lupton soils formed in organic material more than 50 inches thick. Tawas soils are sandy at a depth of 16 to 50 inches. Ensley soils are poorly drained and are in the slightly higher landscape positions. They are loamy. Onaway soils are well drained and are higher on the landscape than the Cathro soils.

Typical pedon of Cathro muck, in an area of Cathro-Ensley complex, 2,105 feet west and 50 feet south of the northeast corner of sec. 3, T. 32 N., R. 25 W., Menominee Township:

Oa1—0 to 6 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 50 percent fiber, less than 15 percent rubbed; weak medium granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

Oa2—6 to 11 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 50 percent fiber, 12 percent rubbed; weak fine granular structure; friable; many very fine and common medium roots; slightly acid; clear smooth boundary.
Oa3—11 to 22 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 50 percent fiber, 15 percent rubbed; weak fine granular structure; friable; common very fine roots; slightly acid; clear smooth boundary.
A—22 to 25 inches; very dark gray (10YR 3/1) sandy loam; many medium prominent brownish yellow (10YR 6/8) and common medium prominent light brownish gray (2.5Y 6/2) mottles; massive; friable; mildly alkaline; clear smooth boundary.
Cg1—25 to 31 inches; grayish brown (2.5Y 5/2) sandy loam; common medium prominent brownish yellow (10YR 6/6) and gray (5Y 6/1) mottles; massive; friable; mildly alkaline; diffuse wavy boundary.
Cg2—31 to 60 inches; light yellowish brown (10YR 6/4) sandy loam; many medium prominent brownish yellow (10YR 6/8) and light brownish gray (2.5Y 6/2) mottles; massive; friable; moderately alkaline.

The depth to loamy material ranges from 16 to 50 inches. Woody fragments make up about 10 percent of the organic material in some pedons. The content of fiber ranges from 5 to 50 percent before rubbing and is less than 16 percent after rubbing.

The surface and subsurface tiers have hue of 5YR or 7.5YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2. The Cg horizon has hue of 5YR, 7.5YR, 10YR, or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is dominantly sandy loam, but the range includes loam, silt loam, and fine sandy loam.

Chippeny Series

The Chippeny series consists of moderately deep and deep, very poorly drained, moderately permeable or moderately slowly permeable, organic soils in depressional areas on till plains. These soils formed in decomposed woody material 20 to 50 inches deep over limestone. Slope is 0 to 2 percent.

Chippeny soils are commonly adjacent to Cunard, Nahma, and Sundell soils. Cunard soils are well drained and are in the higher landscape positions. Nahma soils are poorly drained and are in landscape positions similar to those of the Chippeny soils. Sundell soils are somewhat poorly drained and are slightly higher on the landscape than the Chippeny soils.

Typical pedon of Chippeny muck, in an area of Chippeny-Nahma mucks, about 3,050 feet east and 950 feet north of the southwest corner of sec. 2, R. 26 W., T. 37 N., Nadeau Township:

Oa1—0 to 11 inches; sapric material, black (N 2/0) broken face and rubbed; about 5 percent fiber, 2 percent rubbed; weak medium subangular blocky structure; very friable; many fine roots; slightly acid; clear wavy boundary.
Oa2—11 to 30 inches; sapric material, black (N 2/0) broken face, black (10YR 2/1) rubbed; about 20 percent fiber, 5 percent rubbed; weak coarse subangular blocky structure; very friable; neutral; abrupt wavy boundary.
2R—30 inches; limestone bedrock.

The depth to limestone ranges from 20 to 50 inches. Some pedons have a 2C horizon. The surface and subsurface tiers have hue of 7.5YR or 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2. Some pedons have thin layers of hemic material.

Cunard Series

The Cunard series consists of moderately deep, well drained, moderately permeable soils on moraines, till plains, and drumlins. These soils formed in calcareous, loamy glacial till over limestone. Slopes range from 0 to 8 percent.

Cunard soils are similar to Onaway soils and are commonly adjacent to Onaway, Summerville, and Sundell soils. Onaway soils are underlain by bedrock at a depth of more than 60 inches. Summerville soils are underlain by bedrock at a depth of 10 to 20 inches. They are in landscape positions similar to those of the Cunard soils. Sundell soils are somewhat poorly drained and are lower on the landscape than the Cunard soils.

Typical pedon of Cunard fine sandy loam, in an area of Cunard-Onaway fine sandy loams, 0 to 6 percent slopes, 800 feet north and 500 feet east of the southwest corner of sec. 31, T. 37 N., R. 27 W., Holmes Township:

Oe—2 inches to 0; black (5YR 2/1), partially decomposed forest litter; weak fine granular structure; very friable; many roots; neutral; abrupt smooth boundary.
A—0 to 4 inches; black (10YR 2/1) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure parting to moderate fine granular; very friable; many very fine to medium roots; about 1 percent pebbles; neutral; clear wavy boundary.
E/B—4 to 11 inches; brown (7.5YR 5/4) fine sandy loam (E) and dark brown (7.5YR 4/4) fine sandy loam (Bt); about 60 percent, by volume, E material; moderate medium subangular blocky structure; very friable; common fine and many very fine roots; about 4 percent pebbles; neutral; clear irregular boundary.
Bt1—11 to 17 inches; yellowish red (5YR 4/6) fine sandy loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few very fine, common fine, and many medium roots; common moderately thick dark reddish brown (5YR

3/3) clay films on faces of peds; about 6 percent pebbles; mildly alkaline; clear irregular boundary.
Bt2—17 to 24 inches; reddish brown (5YR 4/4) gravelly fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; common moderately thick dark reddish brown (5YR 3/3) clay films on faces of peds; about 18 percent pebbles and 2 percent cobbles; slight effervescence; mildly alkaline; gradual wavy boundary.
C—24 to 28 inches; brown (7.5YR 5/4) gravelly fine sandy loam; weak fine subangular blocky structure; friable; few fine and medium roots; about 23 percent pebbles and 2 percent cobbles; slight effervescence; moderately alkaline; abrupt broken boundary.
2R—28 inches; limestone.

The thickness of the solum and the depth to limestone range from 20 to 40 inches. The content of pebbles ranges from 1 to 20 percent in the solum and from 5 to 30 percent in the substratum. The content of cobbles ranges from 0 to 10 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly fine sandy loam, but the range includes loam. Cultivated areas have an Ap horizon. The E/B horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. The Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. The E/B and Bt horizons are fine sandy loam, loam, or the gravelly analogs of these textures. The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is gravelly fine sandy loam or gravelly sandy loam.

Dawson Series

The Dawson series consists of deep, very poorly drained, extremely acid, organic soils in bogs on lake plains and till plains. These soils formed in decomposed herbaceous material 16 to 50 inches deep over sandy material. Permeability is moderately slow to moderately rapid in the organic material and rapid in the sandy material. Slope is 0 to 2 percent.

Dawson soils are similar to Loxley soils and are commonly adjacent to Loxley, Rousseau, and Tawas soils. Loxley soils formed in more than 50 inches of organic material. Rousseau soils are well drained or moderately well drained and are higher on the landscape than the Dawson soils. Tawas soils are less acid than the Dawson soils. They are in landscape positions similar to those of the Dawson soils.

Typical pedon of Dawson peat, in an area of the Loxley-Dawson association, 2,500 feet west and 2,500 feet north of the southeast corner of sec. 33, T. 34 N., R. 27 W., Mellen Township:

Oi—0 to 6 inches; fibric material, light yellowish brown (10YR 6/4) broken face, very pale brown (10YR 7/4) rubbed; about 95 percent fiber, 90 percent rubbed; massive; very friable; many fine roots; primarily sphagnum moss fibers; extremely acid; abrupt smooth boundary.
Oa1—6 to 11 inches; sapric material, dark reddish brown (5YR 3/3) broken face, dark reddish brown (5YR 2/2) rubbed; about 30 percent fiber, 10 percent rubbed; moderate very thick platy structure; very friable; few fine roots; extremely acid; clear smooth boundary.
Oa2—11 to 22 inches; sapric material, black (5Y 2/1) broken face and rubbed; about 15 percent fiber, 5 percent rubbed; massive; very friable; extremely acid; clear smooth boundary.
A—22 to 25 inches; very dark gray (10YR 3/1) mucky fine sand; massive; very friable; extremely acid; clear smooth boundary.
C—25 to 60 inches; dark brown (7.5YR 4/4) fine sand; massive; very friable; very strongly acid.

The depth to sandy material ranges from 16 to 50 inches. Woody fragments make up about 10 percent of the organic material in some pedons.

The surface tier has hue of 5YR or 10YR, value of 3 to 6, and chroma of 1 to 4. It is 3 to 9 inches of fibric material derived mainly from sphagnum moss. The subsurface and bottom tiers are dominantly sapric material derived from herbaceous plants, but some pedons have as much as 10 inches of hemic material. The C horizon has hue of 2.5Y or 7.5YR and chroma of 2 to 4. It is fine sand or loamy fine sand.

Deford Series

The Deford series consists of deep, poorly drained, rapidly permeable soils on deltas, lake plains, and outwash plains. These soils formed in sandy glaciolacustrine sediments. Slope is 0 to 2 percent.

Deford soils are commonly adjacent to Rousseau, Tawas, and Wainola soils. Rousseau soils are well drained and are in the higher landscape positions. Tawas soils formed in 16 to 50 inches of organic material. They are in the lower landscape positions. Wainola soils are somewhat poorly drained and are slightly higher on the landscape than the Deford soils.

Typical pedon of Deford mucky fine sand, in an area of Deford-Wainola-Rousseau complex, 0 to 12 percent slopes, 1,700 feet east and 700 feet north of the southwest corner of sec. 27, T. 36 N., R. 25 W., Cedarville Township:

Oa—0 to 4 inches; black (5YR 2/1) muck; about 40 percent fiber, 5 percent rubbed; weak fine granular structure; very friable; many fine roots; medium acid; abrupt smooth boundary.
A—4 to 7 inches; black (10YR 2/1) mucky fine sand; weak medium subangular blocky structure; very

friable; common fine roots; medium acid; abrupt wavy boundary.
C1—7 to 13 inches; grayish brown (10YR 5/2) fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; few fine roots; slightly acid; gradual wavy boundary.
C2—13 to 34 inches; brown (10YR 5/3) fine sand; single grain; loose; thin strata of silt loam; neutral; gradual wavy boundary.
C3—34 to 60 inches; dark reddish brown (5YR 3/3) fine sand; single grain; loose; slightly acid.

The Oa horizon is 2 to 5 inches thick. The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is dominantly mucky fine sand, but the range includes fine sand. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 6, and chroma of 1 to 4. It is dominantly fine sand, but it has strata of silt loam, very fine sand, loamy fine sand, or loamy sand.

Detour Series

The Detour series consists of deep, somewhat poorly drained, moderately slowly permeable soils on till plains and lake benches. These soils formed in loamy glacial till. Slope ranges from 2 to 6 percent.

The Detour soils in this survey area have slightly less clay in the control section than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Detour soils are commonly adjacent to Cathro, Ensley, and Johnswood soils. Cathro and Ensley soils are lower on the landscape than the Detour soils. Cathro soils formed in organic material 15 to 50 inches deep over loamy material. Ensley soils are poorly drained. Johnswood soils are moderately well drained and are slightly higher on the landscape than the Detour soils. Their content of pebbles and cobbles is more than 35 percent.

Typical pedon of Detour loam, in an area of Johnswood-Detour complex, 2 to 6 percent slopes, very stony, 1,900 feet east and 100 feet south of the northwest corner of sec. 36, T. 36 N., R. 25 W., Cedarville Township:

A—0 to 5 inches; black (N 2/0) loam, dark gray (10YR 4/1) dry; moderate medium granular structure; very friable; common fine and medium and few coarse roots; about 3 percent pebbles and 2 percent cobbles; neutral; abrupt wavy boundary.
Bw—5 to 12 inches; dark brown (7.5YR 4/4) fine sandy loam; common medium distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; friable; common fine and medium and few coarse roots; common medium very dark grayish brown (10YR 3/2) worm casts; about 10 percent pebbles and 3 percent cobbles; mildly alkaline; clear wavy boundary.
BC—12 to 19 inches; brown (7.5YR 4/4) fine sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common fine and medium roots; about 10 percent pebbles and 4 percent cobbles; mildly alkaline; clear wavy boundary.
2Cx—19 to 60 inches; light brown (7.5YR 6/4) gravelly fine sandy loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium platy structure parting to moderate medium subangular blocky; firm; about 20 percent pebbles and 10 percent cobbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 15 to 24 inches. The content of pebbles and cobbles ranges from 5 to 20 percent in the solum and from 25 to 35 percent in the substratum.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The Bw horizon has hue of 7.5YR or 10YR and value of 3 to 6. It is fine sandy loam, loam, sandy clay loam, or the cobbly analogs of these textures. The 2Cx horizon has value of 4 to 6 and chroma of 3 or 4.

Ensign Series

The Ensign series consists of shallow, somewhat poorly drained, moderately permeable soils on till plains. These soils formed in loamy material 10 to 20 inches deep over limestone bedrock. Slope is 0 to 3 percent.

Ensign soils are commonly adjacent to Nahma, Ruse, Summerville, and Sundell soils. Nahma and Ruse soils are poorly drained and are lower on the landscape than the Ensign soils. Summerville soils are well drained and are higher on the landscape than the Ensign soils. Sundell soils are somewhat poorly drained and are in the slightly higher positions on the landscape. They are underlain by bedrock at a depth of 20 to 40 inches.

Typical pedon of Ensign loam, in an area of Sundell-Ensign loams, 0 to 3 percent slopes, 1,300 feet south and 1,200 feet west of the northeast corner of sec. 24, T. 37 N., R. 27 W., Nadeau Township:

Oi—1 inch to 0; light yellowish brown (10YR 6/4) recent leaf litter; slightly acid; abrupt smooth boundary.
A—0 to 5 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; many fine and few coarse roots; about 2 percent pebbles and 1 percent cobbles; neutral; clear wavy boundary.
AB—5 to 11 inches; dark brown (10YR 3/3) fine sandy loam (A) and brown (7.5YR 4/4) fine sandy loam (B); common fine faint reddish yellow (7.5YR 6/6)

mottles; moderate fine subangular blocky structure parting to moderate fine granular; friable; few fine and medium roots; about 4 percent pebbles and 1 percent cobbles; neutral; clear wavy boundary.
Bw—11 to 15 inches; strong brown (7.5YR 5/6) fine sandy loam; many coarse distinct reddish yellow (7.5YR 6/8) and few fine distinct light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; few fine roots; about 8 percent pebbles and 2 percent cobbles; slight effervescence; mildly alkaline; abrupt smooth boundary.
2R—15 inches; limestone.

The thickness of the solum and the depth to bedrock range from 10 to 20 inches. The solum is loam or fine sandy loam. The A and AB horizons have hue of 7.5YR or 10YR and value of 2 or 3. The Bw horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. Some pedons have a C horizon.

Ensley Series

The Ensley series consists of deep, poorly drained soils on moraines. These soils formed in calcareous, loamy glacial till. Permeability is moderate in the upper part of the profile and moderately rapid in the lower part. Slope is 0 to 2 percent.

Ensley soils are similar to Minocqua soils and are commonly adjacent to Cathro, Onaway, and Solona soils. Minocqua soils are dominantly very gravelly sand and sand in the substratum. Cathro soils formed in organic material 16 to 50 inches deep over loamy material. They are slightly lower on the landscape than the Ensley soils. The well drained Onaway soils and the somewhat poorly drained Solona soils are in the higher landscape positions.

Typical pedon of Ensley mucky silt loam, in an area of Cathro-Ensley complex, 3,100 feet north and 1,900 feet west of the southeast corner of sec. 36, T. 38 N., R. 28 W., Faithorn Township:

Oa—0 to 4 inches; black (N 2/0) muck; moderate fine granular structure; very friable; common fine and medium roots; neutral; abrupt smooth boundary.
A—4 to 6 inches; black (N 2/0) mucky silt loam; moderate fine granular structure; very friable; common fine and medium roots; neutral; clear smooth boundary.
Bw1—6 to 13 inches; dark grayish brown (10YR 4/2) loam; common fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; few fine and medium roots; black (N 2/0) organic stains along root channels; about 5 percent pebbles; neutral; clear wavy boundary.
2Bw2—13 to 18 inches; yellowish brown (10YR 5/4) fine sandy loam; common fine faint yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine and medium roots; about 8 percent pebbles; neutral; clear wavy boundary.
2C—18 to 60 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; common fine faint yellowish brown (10YR 5/6) and yellow (10YR 7/6) mottles; massive; friable; about 26 percent pebbles; slight effervescence; mildly alkaline.

The solum ranges from 15 to 30 inches in thickness. The content of pebbles and cobbles ranges from 0 to 30 percent throughout the profile.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly mucky silt loam, but the range includes loam, silt loam, and mucky loam. The Bw horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 8. It is loam, fine sandy loam, or sandy loam. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 4. It is fine sandy loam, sandy loam, or the gravelly analogs of these textures.

Gladwin Series

The Gladwin series consists of deep, somewhat poorly drained soils on outwash plains and lake plains. These soils formed in stratified, sandy glacial drift. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slope is 0 to 3 percent.

Gladwin soils are similar to Ingalls and Wainola soils and are commonly adjacent to Mancelona, Minocqua, and Nadeau soils. Ingalls soils have more silt and clay in the substratum than the Gladwin soils, and Wainola soils have less clay in the lower part of the solum. The somewhat excessively drained Mancelona soils and the well drained Nadeau soils are higher on the landscape than the Gladwin soils. The poorly drained Minocqua soils are in the lower landscape positions.

Typical pedon of Gladwin loamy sand, 0 to 3 percent slopes, 1,600 feet north and 900 feet east of the southwest corner of sec. 16, T. 34 N., R. 26 W., Ingallston Township:

Oa—3 inches to 0; black (10YR 2/1), well decomposed organic material; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.
E—0 to 3 inches; light brownish gray (10YR 6/2) loamy sand; weak fine subangular blocky structure; very friable; common fine and medium and few coarse roots; about 2 percent pebbles; strongly acid; clear wavy boundary.
Bs1—3 to 10 inches; reddish brown (5YR 4/4) loamy sand; few fine and medium faint strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very friable; common fine and medium

roots; about 2 percent pebbles; strongly acid; clear wavy boundary.
Bs2—10 to 17 inches; dark brown (7.5YR 4/4) loamy sand; common fine and medium faint yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; common fine and medium roots; about 2 percent pebbles; strongly acid; clear wavy boundary.
Bt—17 to 25 inches; strong brown (7.5YR 5/6) loamy sand; common fine and medium distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; few fine and medium roots; few distinct dark brown (7.5YR 4/4) clay bridges between sand grains; about 4 percent pebbles; strongly acid; clear irregular boundary.
BC—25 to 32 inches; dark yellowish brown (10YR 4/4) loamy sand; common fine and medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; few prominent reddish brown (5YR 4/4) clay bridges between sand grains; about 4 percent pebbles; slightly acid; clear wavy boundary.
C—32 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 4 percent pebbles; violent effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 40 inches. The content of pebbles ranges from 2 to 25 percent throughout the profile.

Some pedons have an A horizon. This horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 or 3. The Bs horizon has hue of 5YR or 7.5YR. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is loamy sand, sandy loam, or the gravelly analogs of these textures. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. It is sand or gravelly sand.

Grayling Series

The Grayling series consists of deep, excessively drained, rapidly permeable soils on outwash plains. These soils formed in sandy glaciofluvial sediments. Slope ranges from 3 to 12 percent.

Grayling soils are commonly adjacent to Deford, Pemene, and Tawas soils. The poorly drained Deford and very poorly drained Tawas soils are lower on the landscape than the Grayling soils. Deford soils have a substratum of dominantly fine sand. Tawas soils formed in organic material over sandy material. Pemene soils have more silt and clay throughout than the Grayling soils. They are in landscape positions similar to those of the Grayling soils.

Typical pedon of Grayling sand, 3 to 12 percent slopes, 1,300 feet south and 2,100 feet east of the northwest corner of sec. 20, T. 35 N., R. 28 W., Lake Township:

A—0 to 4 inches; black (N 2/0) sand, very dark gray (10YR 3/1) dry; weak medium granular structure; very friable; many fine roots; extremely acid; abrupt wavy boundary.
Bw1—4 to 11 inches; strong brown (7.5YR 5/6) sand; weak fine subangular blocky structure; very friable; common fine roots; very strongly acid; clear wavy boundary.
Bw2—11 to 30 inches; strong brown (7.5YR 5/6) sand; single grain; loose; common fine roots; very strongly acid; clear wavy boundary.
C—30 to 60 inches; reddish yellow (7.5YR 6/6) sand; single grain; loose; few fine roots; very strongly acid.

The thickness of the solum ranges from 15 to 30 inches. The A horizon has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 to 4 and chroma of 0 to 2. Some pedons have an E horizon. The Bw horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 6. Some pedons have a BC horizon. The C horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 4 to 6.

Ingalls Series

The Ingalls series consists of deep, somewhat poorly drained soils on lake plains and outwash plains. These soils formed in sandy glaciofluvial sediments overlying calcareous lacustrine sediments. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slope is 0 to 3 percent.

Ingalls soils are similar to Gladwin and Wainola soils and are commonly adjacent to Bowers, Burleigh, Solona, and Wainola soils. Gladwin and Wainola soils have less silt and clay in the substratum than the Ingalls soils. Bowers and Solona soils are silty or loamy in the upper part of the solum. They are in landscape positions similar to those of the Ingalls soils. Burleigh soils are poorly drained and are in the slightly lower positions on the landscape.

Typical pedon of Ingalls fine sand, 0 to 3 percent slopes, 1,260 feet west and 950 feet north of the southeast corner of sec. 21, T. 33 N., R. 26 W., Ingallston Township:

A—0 to 3 inches; black (N 2/0) fine sand, dark brown (7.5YR 3/2) dry; moderate fine granular structure; very friable; many fine and medium and few coarse roots; strongly acid; abrupt smooth boundary.
E—3 to 11 inches; grayish brown (10YR 5/2) fine sand; weak fine subangular blocky structure; very friable; many fine and medium roots; strongly acid; clear wavy boundary.
Bh—11 to 14 inches; dark brown (7.5YR 3/2) fine sand; few fine prominent yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; very friable; common fine and medium roots; small chunks of

discontinuous ortstein; medium acid; clear wavy boundary.

Bs1—14 to 22 inches; reddish yellow (7.5YR 6/6) fine sand; common fine distinct yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine and medium roots; neutral; gradual wavy boundary.

Bs2—22 to 25 inches; strong brown (7.5YR 5/6) fine sand; common fine distinct brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; friable; few fine roots; neutral; abrupt wavy boundary.

2C—25 to 60 inches; light reddish brown (5YR 6/4) and light gray (5YR 7/1) stratified silt loam and silt; common medium distinct yellowish red (5YR 5/6) mottles; massive; firm; few fine roots; about 2 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The content of pebbles ranges from 0 to 5 percent in the solum.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly fine sand, but the range includes sand and loamy sand. Some pedons have an Ap horizon. The E horizon has hue of 7.5YR or 10YR and value of 5 or 6. It is fine sand or sand. The Bs horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 4 to 6. It is dominantly fine sand, but the range includes loamy fine sand, sand, and loamy sand. Some pedons have chunks of ortstein as much as 4 inches in diameter. The 2C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly stratified silt and silt loam, but it is loamy fine sand or has strata of sand or silty clay loam in some pedons.

Johnswood Series

The Johnswood series consists of deep, moderately well drained, moderately slowly permeable soils on till plains and lake plains. These soils formed in cobbly and gravelly, loamy glacial till. Slope ranges from 2 to 6 percent.

Johnswood soils are commonly adjacent to Cathro, Detour, and Ensley soils. The adjacent soils are lower on the landscape than the Johnswood soils. Cathro soils formed in organic material 16 to 50 inches deep over loamy material and are very poorly drained. Detour soils are somewhat poorly drained. Ensley soils are poorly drained. They have a lower content of coarse fragments than the Johnswood soils.

Typical pedon of Johnswood cobbly loam, in an area of Johnswood-Detour complex, 2 to 6 percent slopes, very stony, 2,000 feet south and 1,000 feet east of the northwest corner of sec. 36, T. 36 N., R. 25 W., Cedarville Township:

A—0 to 2 inches; black (10YR 2/1) cobbly loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure parting to moderate medium granular; friable; many fine to coarse roots; about 20 percent stones, 10 percent cobbles, and 5 percent pebbles; neutral; clear wavy boundary.

A/B—2 to 5 inches; black (10YR 2/1) cobbly loam (A) and dark brown (7.5YR 4/4) cobbly loam (B); moderate medium subangular blocky structure parting to moderate fine granular; friable; many fine and medium and common coarse roots; about 15 percent cobbles and 5 percent pebbles; neutral; clear wavy boundary.

Bt1—5 to 13 inches; dark brown (7.5YR 4/4) very cobbly loam; moderate medium subangular blocky structure; friable; common dark reddish brown (5YR 3/4) clay films on faces of peds; common fine and medium roots; about 32 percent cobbles and 5 percent pebbles; mildly alkaline; clear irregular boundary.

Bt2—13 to 16 inches; dark reddish brown (5YR 3/4) very gravelly fine sandy loam; few fine faint yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; friable; common fine and medium roots; few distinct dark reddish brown (5YR 3/4) clay films on faces of peds; about 5 percent cobbles and 30 percent pebbles; mildly alkaline; clear irregular boundary.

Cx—16 to 60 inches; light brown (7.5YR 6/4) gravelly fine sandy loam; common medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; about 5 percent cobbles and 25 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 10 to 20 inches. The content of pebbles, cobbles, and stones ranges from 35 to 70 percent in the solum and from 25 to 60 percent in the substratum.

Some pedons have as much as 4 inches of well decomposed organic material at the surface. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly cobbly loam, but the range includes cobbly sandy loam. The texture of the A/B horizon is similar to that of the A horizon. The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5, and chroma of 3 to 6. It is the very cobbly, cobbly, gravelly, or very gravelly analogs of loam or fine sandy loam. The Cx horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4. It is gravelly or very gravelly fine sandy loam.

Loxley Series

The Loxley series consists of deep, very poorly drained, extremely acid, moderately slowly permeable to moderately rapidly permeable, organic soils in bogs on

till plains and lake plains. These soils formed in decomposed herbaceous material. Slope is 0 to 2 percent.

Loxley soils are similar to Dawson soils and are commonly adjacent to Dawson, Rousseau, and Tawas soils. Dawson soils have sandy material at a depth of 16 to 50 inches. Rousseau soils are well drained and are higher on the landscape than the Loxley soils. They are sandy throughout. Tawas soils are less acid than the Loxley soils. They are in landscape positions similar to those of the Loxley soils.

Typical pedon of Loxley peat, in an area of the Loxley-Dawson association, 156 feet north and 625 feet east of the southwest corner of sec. 19, T. 35 N., R. 25 W., Cedarville Township:

Oi—0 to 8 inches; fibric material, light yellowish brown (10YR 6/4) broken face and rubbed; 100 percent fiber, 95 percent rubbed; massive; nonsticky; primarily sphagnum fibers; common fine and few coarse roots; extremely acid; abrupt wavy boundary.

Oa—8 to 12 inches; sapric material, dark reddish brown (5YR 2/2) broken face and rubbed; about 20 percent fiber, 5 percent rubbed; weak medium platy structure parting to moderate fine granular; few fine and medium roots; extremely acid; clear wavy boundary.

Oe—12 to 16 inches; hemic material, dark reddish brown (5YR 3/2) broken face and rubbed; about 60 percent fiber, 25 percent rubbed; massive; extremely acid; clear wavy boundary.

O'a—16 to 60 inches; sapric material, dark reddish brown (5YR 3/2) broken face and rubbed; about 25 percent fiber, 10 percent rubbed; massive; extremely acid.

The organic material is more than 50 inches thick. It is derived mainly from herbaceous material. The fibric material in the upper part of the profile ranges from 3 to 18 inches in thickness. The hemic material in the subsurface and bottom tiers is less than 10 inches thick.

Lupton Series

The Lupton series consists of deep, very poorly drained, moderately slowly permeable to moderately rapidly permeable, organic soils in bogs and depressions on lake plains, till plains, and outwash plains. These soils formed in decomposed woody material. Slope is 0 to 2 percent.

Lupton soils are similar to Cathro and Tawas soils and are commonly adjacent to Cathro, Onaway, and Tawas soils. Cathro soils have loamy material at a depth of 16 to 50 inches. Tawas soils have sandy material at a depth of 16 to 50 inches. Onaway soils are well drained and are higher on the landscape than the Lupton soils. They are loamy throughout.

Typical pedon of Lupton muck, in an area of the Lupton-Cathro association, 850 feet south and 6 feet east of the northwest corner of sec. 5, T. 32 N., R. 27 W., Menominee Township:

Oa1—0 to 5 inches; sapric material, black (N 2/0) broken face and rubbed; about 20 percent fiber, 5 percent rubbed; weak thin platy structure; very friable; many fine roots; slightly acid; clear wavy boundary.

Oa2—5 to 10 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 50 percent fiber, 5 percent rubbed; weak coarse subangular blocky structure; very friable; few fine roots; slightly acid; gradual wavy boundary.

Oa3—10 to 38 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 50 percent fiber, 8 percent rubbed; weak medium subangular blocky structure; very friable; few fine roots; neutral; gradual wavy boundary.

Oa4—38 to 60 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 10 percent fiber, 2 percent rubbed; massive; very friable; slightly acid.

In some pedons the content of woody fragments is as much as 30 percent. In some pedons hemic layers less than 10 inches thick are below the surface tier. The organic material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

Mancelona Series

The Mancelona series consists of deep, somewhat excessively drained soils on outwash plains and moraines. These soils formed in sandy and loamy glaciofluvial deposits. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 0 to 8 percent.

Mancelona soils are commonly adjacent to Gladwin, Nadeau, and Tawas soil. The somewhat poorly drained Gladwin and very poorly drained Tawas soils are lower on the landscape than the Mancelona soils. Tawas soils formed in organic material over sandy material.

Typical pedon of Mancelona loamy sand, in an area of Mancelona-Nadeau complex, 0 to 8 percent slopes, 400 feet north and 1,150 feet east of the southwest corner of sec. 15, T. 34 N., R. 26 W., Ingallston Township:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, brown (10YR 5/3) dry; weak medium subangular blocky structure; very friable; common very fine and fine and few medium roots; about 2 percent pebbles; slightly acid; abrupt smooth boundary.

E—9 to 12 inches; brown (7.5YR 5/4) loamy sand; weak fine subangular blocky structure; very friable; about

2 percent pebbles; slightly acid; clear broken boundary.
Bs—12 to 24 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; about 2 percent pebbles; slightly acid; clear wavy boundary.
Bt—24 to 32 inches; reddish brown (5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; common faint dark reddish brown (5YR 3/3) clay films on faces of peds; about 5 percent pebbles; neutral; clear irregular boundary.
2C—32 to 60 inches; light yellowish brown (10YR 6/4) stratified gravelly sand and sand; single grain; loose; about 20 percent pebbles; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 40 inches. The content of pebbles ranges from 3 to 25 percent in the solum and from 10 to 50 percent in the 2C horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly loamy sand, but the range includes sandy loam. Pedons in wooded areas have an A horizon. The E and Bs horizons are loamy sand or sand. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. The Bs horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam, loamy sand, or the gravelly analogs of these textures. The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is dominantly stratified gravelly sand and sand, but the range includes coarse sand and very gravelly sand.

Minocqua Series

The Minocqua series consists of deep, poorly drained soils in drainageways and depressions on moraines and outwash plains. These soils formed in loamy material overlying calcareous, sandy and gravelly material. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slope is 0 to 2 percent.

The Minocqua soils in this survey area are brighter colored in the lower part of the subsoil than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Minocqua soils are similar to Ensley soils and are commonly adjacent to Banat, Nadeau, and Tawas soils. Ensley soils have a loamy substratum. The somewhat poorly drained Banat soils and the well drained Nadeau soils are in the higher landscape positions. The very poorly drained Tawas soils formed in organic material over mineral material. They are in landscape positions similar to those of the Minocqua soils.

Typical pedon of Minocqua mucky silt loam, in an area of Minocqua-Tawas complex, 2,000 feet east and 200 feet south of the northwest corner of sec. 12, T. 36 N., R. 28 W., Holmes Township:

Oa—0 to 4 inches; black (N 2/0) muck, black (N 2/0) dry; moderate medium granular structure; friable; many very fine and fine and common medium roots; neutral; abrupt wavy boundary.
A—4 to 7 inches; black (N 2/0) mucky silt loam; moderate medium and fine granular structure; friable; many fine and medium roots; neutral; abrupt smooth boundary.
Bw1—7 to 10 inches; dark grayish brown (10YR 4/2) loam; common fine distinct reddish yellow (7.5YR 6/6) and common medium distinct very dark gray (10YR 3/1) mottles; moderate fine subangular blocky structure; friable; common fine roots; about 5 percent pebbles; neutral; clear wavy boundary.
Bw2—10 to 14 inches; dark yellowish brown (10YR 4/4) fine sandy loam; common fine distinct dark grayish brown (10YR 4/2) and reddish yellow (7.5YR 6/6) mottles; moderate fine subangular blocky structure; friable; few fine roots; about 5 percent pebbles; neutral; clear wavy boundary.
BC—14 to 22 inches; yellowish brown (10YR 5/4) gravelly sandy loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; few fine roots; about 20 percent pebbles; mildly alkaline; gradual wavy boundary.
2C—22 to 60 inches; yellowish brown (10YR 5/4), stratified sand and very gravelly sand; common fine faint grayish brown (10YR 5/2) mottles; single grain; loose; about 60 percent pebbles; strong effervescence; moderately alkaline.

The solum is 20 to 25 inches thick. The content of pebbles ranges from 0 to 10 percent in the A horizon and the upper part of the B horizon, from 0 to 35 percent in the lower part of the B horizon, and from 20 to 60 percent in the 2C horizon.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is dominantly mucky silt loam, but the range includes mucky fine sandy loam and loam. The Bw and BC horizons have hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 4. They are sandy loam, fine sandy loam, loam, or the gravelly analogs of these textures. The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is dominantly stratified sand and very gravelly sand, but the range includes gravelly sand, coarse sand, and gravelly or very gravelly coarse sand.

Moquah Series

The Moquah series consists of deep, moderately well drained, moderately permeable soils on incised flood

plains along rivers and streams. These soils formed in loamy and sandy alluvium on bottom land. Slope is 0 to 3 percent.

Moquah soils are commonly adjacent to Arnheim, Nadeau, and Rubicon soils. Arnheim soils are poorly drained and are lower on the landscape than the Moquah soils. Nadeau and Rubicon soils are higher on the landscape than the Moquah soils. Nadeau soils have a substratum of very gravelly coarse sand or very gravelly sand. Rubicon soils have more sand in the subsoil than the Moquah soils.

Typical pedon of Moquah loam, in an area of Arnheim-Moquah complex, 0 to 3 percent slopes, 1,280 feet west and 50 feet north of the southeast corner of sec. 11, T. 34 N., R. 29 W., Lake Township:

A—0 to 2 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; many fine, common medium, and few coarse roots; slightly acid; abrupt smooth boundary.

C1—2 to 11 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; friable; common fine and few medium and coarse roots; common fine black (N 2/0) concretions; slightly acid; clear wavy boundary.

C2—11 to 22 inches; reddish brown (5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine and few medium roots; common fine black (N 2/0) concretions; medium acid; clear wavy boundary.

C3—22 to 30 inches; reddish brown (5YR 4/4) fine sandy loam; common medium distinct yellowish red (5YR 5/6) mottles; weak thin platy structure; very friable; few fine roots; common fine black (N 2/0) concretions; about 2 percent pebbles; medium acid; clear wavy boundary.

C4—30 to 41 inches; light brown (7.5YR 6/4) fine sand; common medium distinct yellowish red (5YR 5/6) mottles; single grain; loose; about 2 percent pebbles; medium acid; clear wavy boundary.

C5—41 to 60 inches; yellowish red (5YR 4/6) sand; common medium distinct dark reddish brown (5YR 3/4) mottles; single grain; loose; common medium distinct yellowish red (5YR 5/6) organic stains; about 3 percent pebbles; medium acid.

The thickness and texture of individual horizons vary considerably because of the nature of the parent material. The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 to 4, and chroma of 1 to 3. It is dominantly loam, but the range includes silt loam and fine sandy loam. The C horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 3 to 6. It is loam, silt loam, fine sandy loam, fine sand, or sand.

Nadeau Series

The Nadeau series consists of deep, well drained soils on eskers, outwash plains, kames, and stream terraces. These soils formed in loamy material and in stratified, calcareous gravel and sand. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 0 to 35 percent.

Nadeau soils are commonly adjacent to Banat, Minocqua, Onaway, and Tawas soils. Banat soils are somewhat poorly drained and are in the slightly lower landscape positions. The poorly drained Minocqua and very poorly drained Tawas soils are lower on the landscape than the Nadeau soils. Onaway soils have a loamy substratum. They are in landscape positions similar to those of the Nadeau soils.

Typical pedon of Nadeau fine sandy loam, 3 to 12 percent slopes, 1,900 feet south and 2,300 feet east of the northwest corner of sec. 18, T. 35 N., R. 27 W., Stephenson Township:

Oe—2 inches to 0; black (10YR 2/1), partially decomposed leaf litter; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A—0 to 3 inches; dark brown (7.5YR 3/2) fine sandy loam, brown (7.5YR 5/2) dry; moderate fine and medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—3 to 15 inches; brown (7.5YR 4/4) fine sandy loam; moderate fine subangular blocky structure; friable; many fine roots; about 8 percent pebbles; neutral; abrupt wavy boundary.

2Bt2—15 to 19 inches; reddish brown (5YR 4/4) very gravelly sandy loam; moderate fine subangular blocky structure; friable; many fine roots; few faint reddish brown (5YR 4/3) clay films on faces of peds; about 26 percent pebbles and 10 percent cobbles; slight effervescence; mildly alkaline; clear wavy boundary.

2BC—19 to 30 inches; brown (7.5YR 4/4) very gravelly sand; single grain; loose; common fine roots; about 36 percent pebbles and 20 percent cobbles; strong effervescence; moderately alkaline; gradual wavy boundary.

2C—30 to 60 inches; brown (10YR 5/3) very gravelly coarse sand; single grain; loose; few fine roots; about 38 percent pebbles and 22 percent cobbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates typically are 15 to 30 inches but range from 10 to 40 inches. The content of pebbles ranges from 0 to 25 percent in the upper part of the solum and from 35 to 60 percent in the lower part. The content of cobbles and stones ranges from 0 to 10 percent in the upper part of the solum and from 5 to 20 percent in the lower part.

Some pedons have an Ap horizon. The A and Bt1 horizons are fine sandy loam, loam, sandy loam, or the gravelly analogs of these textures. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. The Bt1 horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. The 2Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 4 to 6. It is very gravelly sandy loam or very gravelly loam. The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is very gravelly coarse sand or very gravelly sand.

Nahma Series

The Nahma series consists of moderately deep, poorly drained, moderately permeable soils in depressions on till plains. These soils formed in calcareous, loamy glacial till over limestone bedrock. Slope is 0 to 2 percent.

Nahma soils are commonly adjacent to Chippeny, Ruse, Summerville, and Sundell soils. Chippeny and Ruse soils are in landscape positions similar to those of the Nahma soils. Chippeny soils formed in organic material 20 to 50 inches deep over limestone. Ruse soils are underlain by limestone at a depth of 10 to 20 inches. Summerville soils formed in loamy material 10 to 20 inches deep over limestone. They are well drained and are higher on the landscape than the Nahma soils. Sundell soils are somewhat poorly drained and are slightly higher on the landscape than the Nahma soils.

Typical pedon of Nahma muck, in an area of Chippeny-Nahma mucks, 1,200 feet east and 100 feet south of the northwest corner of sec. 12, T. 36 N., R. 27 W., Nadeau Township:

Oa—0 to 10 inches; black (N 2/0) muck; strong medium and coarse granular structure; friable; neutral; gradual wavy boundary.

Bg—10 to 17 inches; dark grayish brown (2.5Y 4/2) loam; few fine prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; firm; common black (10YR 2/1) organic stains along root channels; about 5 percent pebbles; mildly alkaline; gradual wavy boundary.

C—17 to 23 inches; reddish yellow (7.5YR 6/6) gravelly sandy loam; few fine faint strong brown (7.5YR 5/6) mottles; massive; friable; about 18 percent pebbles and cobbles; slight effervescence; mildly alkaline; abrupt smooth boundary.

2R—23 inches; limestone bedrock.

The thickness of the solum and the depth to free carbonates are 11 to 20 inches. The depth to limestone is 20 to 40 inches. The content of pebbles and cobbles ranges from 2 to 20 percent in the solum.

The Oa horizon has hue of 10YR or 7.5YR or is neutral in hue. It has chroma of 0 to 2. Some pedons have an A horizon. This horizon is loam, fine sandy loam, or sandy loam. The Bg horizon has hue of 5YR, 7.5YR, or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is loam or fine sandy loam. Some pedons have a BC horizon. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 6. It is dominantly gravelly sandy loam, but the range includes gravelly fine sandy loam.

Onaway Series

The Onaway series consists of deep, well drained, moderately permeable soils on drumlins and moraines. These soils formed in calcareous, loamy glacial till. Slope ranges from 0 to 35 percent.

Onaway soils are similar to Cunard soils and are commonly adjacent to Cathro, Cunard, Ensley, and Solona soils. Cunard soils are underlain by limestone bedrock at a depth of 20 to 40 inches. The very poorly drained Cathro, poorly drained Ensley, and somewhat poorly drained Solona soils are lower on the landscape than the Onaway soils. Cathro soils formed in organic material over loamy material.

Typical pedon of Onaway fine sandy loam, 3 to 9 percent slopes, 1,300 feet east and 200 feet south of the northwest corner of sec. 9, T. 36 N., R. 25 W., Cedarville Township:

Oa—1 inch to 0; black (N 2/0), well decomposed organic material; weak fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

A—0 to 1 inch; dark brown (7.5YR 3/2) fine sandy loam; weak fine subangular blocky structure; friable; many fine roots; slightly acid; about 2 percent pebbles and cobbles; abrupt wavy boundary.

Bs—1 to 18 inches; dark brown (7.5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; about 3 percent cobbles and pebbles; neutral; abrupt wavy boundary.

Bt—18 to 25 inches; yellowish red (5YR 4/6) loam; moderate fine subangular blocky structure; friable; common fine roots; thin discontinuous dark reddish brown (5YR 3/3) clay films on faces of peds; about 2 percent pebbles and cobbles; neutral; abrupt wavy boundary.

C1—25 to 33 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; about 20 percent pebbles and 3 percent cobbles; strong effervescence; moderately alkaline; clear wavy boundary.

C2—33 to 60 inches; brown (7.5YR 5/4) gravelly fine sandy loam; massive; friable; few fine roots; about 22 percent pebbles and 6 percent cobbles; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 15 to 30 inches. The content of pebbles and cobbles ranges from 2 to 25 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. It is dominantly fine sandy loam, but the range includes loam and sandy loam. Some pedons have an Ap horizon. The Bs horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is fine sandy loam or sandy loam. The Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 4 to 6. It is loam or sandy clay loam. Some pedons have a B/E horizon. The C horizon has hue of 5YR, 7.5YR, or 10YR and value of 5 or 6. It is gravelly fine sandy loam or gravelly sandy loam.

Pemene Series

The Pemene series consists of deep, well drained soils on moraines. These soils formed in calcareous, loamy and sandy glacial till. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid in the lower part. Slope ranges from 3 to 35 percent.

Pemene soils are commonly adjacent to Grayling, Rubicon, and Tawas soils. Grayling and Rubicon soils have a sandy subsoil. They are in landscape positions similar to those of the Pemene soils. Tawas soils formed in organic material over sandy material. They are very poorly drained and are lower on the landscape than the Pemene soils.

Typical pedon of Pemene loamy fine sand, in an area of Pemene-Rubicon complex, 3 to 12 percent slopes, 2,100 feet south and 200 feet east of the northwest corner of sec. 6, T. 34 N., R. 28 W., Lake Township:

Oe—2 inches to 0; black (10YR 2/1), partially decomposed leaf litter; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.

A—0 to 2 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine roots; strongly acid; abrupt wavy boundary.

E—2 to 15 inches; brown (7.5YR 5/4) loamy fine sand; weak fine subangular blocky structure; very friable; many fine roots; few fine dark reddish brown (5YR 3/2) organic stains; about 5 percent pebbles and cobbles; strongly acid; clear wavy boundary.

E/B—15 to 21 inches; brown (7.5YR 5/4) loamy fine sand (E); weak medium platy structure; very friable; E material makes up about 70 percent of the horizon and completely surrounds remnants of reddish brown (5YR 4/4) fine sandy loam (Bt); weak medium subangular blocky structure; friable; common fine and medium roots; few thin clay films on faces of peds in the Bt part; few fine distinct dark reddish brown (5YR 3/2) organic stains; about 8 percent pebbles and cobbles; medium acid; abrupt wavy boundary.

Bt—21 to 30 inches; reddish brown (5YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; common fine and medium roots; thin continuous dark reddish brown (5YR 3/3) clay films; about 9 percent pebbles and cobbles; medium acid; abrupt wavy boundary.

2BC—30 to 37 inches; yellowish red (5YR 4/6) loamy sand; weak medium subangular blocky structure; friable; common fine roots; about 10 percent pebbles and cobbles; neutral; clear wavy boundary.

2C1—37 to 52 inches; light reddish brown (5YR 6/4) gravelly loamy sand; moderate medium subangular blocky structure; friable; few fine roots; discontinuous carbonate accumulations in root pores and on surfaces of cobbles; about 17 percent pebbles and cobbles; slight effervescence; mildly alkaline; abrupt wavy boundary.

2C2—52 to 60 inches; reddish yellow (5YR 6/6) loamy sand; massive; friable; about 12 percent pebbles and cobbles; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 48 inches. The content of pebbles and cobbles ranges from 0 to 10 percent in the solum and from 0 to 17 percent in the C horizon.

Some pedons have an Ap horizon. The A and E horizons are loamy fine sand, loamy sand, or fine sandy loam. The A horizon has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The E horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is fine sandy loam or sandy loam. The C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6. It is loamy sand, fine sandy loam, sandy loam, or the gravelly analogs of these textures.

Pickford Series

The Pickford series consists of deep, poorly drained, very slowly permeable soils on lake plains. These soils formed in stratified, calcareous, silty lacustrine deposits. Slope is 0 to 2 percent.

Pickford soils are commonly adjacent to Bowers, Deford, and Ingalls soils. Bowers and Ingalls soils are somewhat poorly drained and are slightly higher on the landscape than the Pickford soils. Deford soils contain more sand than the Pickford soils. They are in landscape positions similar to those of the Pickford soils.

Typical pedon of Pickford mucky silty clay loam, about 200 feet west and 2,500 feet south of the northeast corner of sec. 7, T. 36 N., R. 24 W., Cedarville Township:

Oe—0 to 1 inch; hemic material, dark reddish brown (5YR 2/2) and black (5YR 2/1) rubbed; about 55 percent fiber, 25 percent rubbed; weak thin platy structure; very friable; many medium and fine roots; mildly alkaline; abrupt smooth boundary.
Oa—1 to 3 inches; sapric material, black (N 2/0 and 5YR 2/1) rubbed; about 30 percent fiber, 5 percent rubbed; moderate fine granular structure; very friable; few medium and many fine roots; mildly alkaline; clear wavy boundary.
Bg1—3 to 7 inches; dark gray (10YR 4/1) silty clay loam; common fine prominent yellowish red (5YR 5/8) mottles; weak very fine subangular blocky structure; firm; many fine roots; neutral; clear wavy boundary.
Bg2—7 to 14 inches; brown (7.5YR 5/2) silty clay loam; common fine distinct yellowish red (5YR 5/6) mottles; moderate very fine subangular blocky structure; firm; very dark grayish brown (10YR 3/2) organic stains on faces of peds; common fine roots; neutral; gradual wavy boundary.
BC—14 to 24 inches; reddish brown (5YR 4/4) silty clay loam; common fine distinct yellowish red (5YR 5/6) and common fine prominent light gray (5YR 6/1) mottles; moderate medium subangular blocky structure; firm; few fine roots; mildly alkaline; gradual wavy boundary.
C—24 to 60 inches; reddish brown (5YR 5/4) silty clay loam; common fine distinct yellowish red (5YR 5/6) and common fine prominent light gray (5YR 6/1) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 15 to 24 inches in thickness. The Oa horizon has hue of 5YR or is neutral in hue. It has chroma of 0 to 2. Some pedons have an A horizon. This horizon is silt loam, silty clay loam, or the mucky analogs of these textures. The Bg horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay or silty clay loam. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly silty clay loam or silty clay but has thin strata of silt loam or clay in some pedons.

Posen Series

The Posen series consists of deep, well drained, moderately permeable soils on drumlins, till plains, and moraines. These soils formed in calcareous, gravelly and cobbly, loamy glacial till. Slope ranges from 3 to 12 percent.

The Posen soils in this survey area have a more strongly developed B horizon than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Posen soils are commonly adjacent to Cathro, Ensley, and Onaway soils. Cathro and Ensley soils are lower on the landscape than the Posen soils. Cathro soils formed in organic material 16 to 50 inches deep over loamy material. Ensley soils are poorly drained. Onaway soils have a lower content of cobbles and pebbles in the subsoil than the Posen soils. They are in landscape positions similar to those of the Posen soils.

Typical pedon of Posen cobbly fine sandy loam, 3 to 12 percent slopes, very stony, 1,700 feet north and 300 feet east of the southwest corner of sec. 29, T. 37 N., R. 26 W., Nadeau Township:

A—0 to 4 inches; dark brown (7.5YR 3/2) cobbly fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; friable; many very fine and fine, common medium, and few coarse roots; about 15 percent cobbles, 5 percent pebbles, and 10 percent stones; slightly acid; abrupt wavy boundary.
E—4 to 8 inches; brown (7.5YR 4/4) gravelly fine sandy loam; weak medium subangular blocky structure; friable; many very fine and fine, common medium, and few coarse roots; about 10 percent pebbles, 9 percent cobbles, and 6 percent stones; neutral; clear wavy boundary.
Bt1—8 to 11 inches; reddish brown (5YR 4/4) very gravelly loam; moderate medium subangular blocky structure; friable; common very fine to medium and few coarse roots; thin discontinuous dark reddish brown (5YR 3/2) clay films on faces of peds; about 24 percent pebbles, 9 percent cobbles, and 6 percent stones; neutral; clear wavy boundary.
Bt2—11 to 15 inches; strong brown (7.5YR 5/6) very gravelly fine sandy loam; weak fine subangular blocky structure; friable; common very fine and fine and few medium roots; thin discontinuous dark reddish brown (5YR 3/2) clay films on faces of peds; about 40 percent pebbles, 12 percent cobbles, and 8 percent stones; neutral; clear wavy boundary.
BC—15 to 22 inches; brown (7.5YR 4/4) extremely gravelly sandy loam; weak fine subangular blocky structure; very friable; about 50 percent pebbles, 18 percent cobbles, and 12 percent stones; slight effervescence; mildly alkaline; clear wavy boundary.
C—22 to 60 inches; brown (10YR 5/3) very gravelly sandy loam; weak medium subangular blocky structure; very friable; about 20 percent pebbles, 18 percent cobbles, and 12 percent stones; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates typically are 17 to 22 inches but range from 15 to 30 inches. In the solum, the content of pebbles ranges from 10 to 50 percent, that of cobbles from 10 to 35 percent, and that of stones from 10 to 20 percent. The content of pebbles, cobbles, and stones ranges from 30 to 60 percent in the substratum.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It

generally is cobbly fine sandy loam, but the range includes loam and cobbly loam. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam or sandy loam. The Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. It is the very gravelly or very cobbly analogs of loam, fine sandy loam, or sandy loam. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. It is very gravelly sandy loam or very cobbly sandy loam.

Rousseau Series

The Rousseau series consists of deep, well drained or moderately well drained, rapidly permeable soils on beach ridges, dunes, outwash plains, lake plains, and river terraces. These soils formed in sandy glaciofluvial and glaciolacustrine sediments. Slope ranges from 0 to 25 percent.

Rousseau soils are similar to Rubicon soils and are commonly adjacent to Deford, Onaway, and Wainola soils. Rubicon soils formed in sandy material that is coarser textured than the parent material of the Rousseau soils. The poorly drained Deford and somewhat poorly drained Wainola soils are lower on the landscape than the Rousseau soils. Onaway soils have more silt and clay throughout than the Rousseau soils. They are in landscape positions similar to those of the Rousseau soils.

Typical pedon of Rousseau fine sand, in an area of Deford-Wainola-Rousseau complex, 0 to 12 percent slopes, 2,500 feet south and 800 feet east of the northwest corner of sec. 5, T. 34 N., R. 25 W., Ingallston Township:

Oa—1 inch to 0; black (N 2/0), well decomposed organic material; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.
A—0 to 1 inch; black (N 2/0) fine sand; moderate fine granular structure; very friable; many fine roots; very strongly acid; abrupt wavy boundary.
E—1 to 4 inches; pinkish gray (5YR 6/2) fine sand; single grain; loose; common fine and few coarse roots; extremely acid; abrupt wavy boundary.
Bs1—4 to 9 inches; dark brown (7.5YR 4/4) fine sand; weak fine subangular blocky structure; very friable; common fine and few medium roots; dark reddish brown (5YR 3/3) discontinuous ortstein; strongly acid; clear wavy boundary.
Bs2—9 to 16 inches; strong brown (7.5YR 5/6) fine sand; weak fine and medium subangular blocky structure; very friable; common fine and few medium roots; medium acid; clear wavy boundary.
BC—16 to 27 inches; strong brown (7.5YR 5/6) fine sand; single grain; loose; few fine roots; medium acid; gradual wavy boundary.
C—27 to 60 inches; pink (7.5YR 7/4) fine sand; single grain; loose; slightly acid.

The thickness of the solum typically is 20 to 30 inches but ranges from 20 to 45 inches. The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The E horizon has hue of 5YR, 7.5YR, or 10YR and value of 5 or 6. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 6, and chroma of 4 to 8. The C horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 3 to 6.

Rubicon Series

The Rubicon series consists of deep, excessively drained, rapidly permeable soils on outwash plains, moraines, river terraces, and beach ridges. These soils formed in sandy glaciofluvial sediments. Slope ranges from 3 to 12 percent.

Rubicon soils are similar to Rousseau soils and are commonly adjacent to Deford, Pemene, and Wainola soils. The poorly drained Deford and somewhat poorly drained Wainola soils are lower on the landscape than the Rubicon soils. Their solum is dominantly fine sand. Pemene soils have more silt and clay in the subsoil than the Rubicon soils. They are in landscape positions similar to those of the Rubicon soils.

Typical pedon of Rubicon sand, 3 to 12 percent slopes, 2,200 feet west and 2,100 feet south of the northeast corner of sec. 35, T. 33 N., R. 28 W., Menominee Township:

Oa—1 inch to 0; black (N 2/0), well decomposed organic material; extremely acid; abrupt smooth boundary.
A—0 to 2 inches; black (N 2/0) sand, dark brown (7.5YR 3/2) dry; weak fine subangular blocky structure; very friable; many fine roots; very strongly acid; abrupt smooth boundary.
E—2 to 6 inches; brown (7.5YR 5/2) sand; weak fine subangular blocky structure; very friable; common fine roots; strongly acid; clear smooth boundary.
Bs1—6 to 9 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; loose; many fine and common medium roots; strongly acid; clear smooth boundary.
Bs2—9 to 15 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; very friable; common fine roots; strongly acid; clear smooth boundary.
Bs3—15 to 24 inches; strong brown (7.5YR 5/8) sand; weak medium subangular blocky structure; very friable; common fine roots; strongly acid; clear smooth boundary.
BC—24 to 36 inches; reddish yellow (7.5YR 6/8) sand; very weak medium subangular blocky structure; very friable; few fine and medium roots; strongly acid; gradual smooth boundary.
C—36 to 60 inches; light brown (7.5YR 6/4) sand; single grain; loose; strongly acid.

The thickness of the solum typically is 21 to 38 inches but ranges from 20 to 50 inches. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 or 2. The A and E horizons are dominantly sand, but the range includes loamy sand. The Bs horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The C horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 4 to 6. It is sand or coarse sand.

Ruse Series

The Ruse series consists of shallow, poorly drained, moderately permeable or moderately rapidly permeable soils in depressions on till plains and moraines. These soils formed in calcareous, loamy glacial till over limestone bedrock. Slope is 0 to 2 percent.

The Ruse soils in this survey area have a brighter colored subsoil and a thicker surface layer than is definitive for the series. These differences, however, do not alter the usefulness or behavior of the soils.

Ruse soils are commonly adjacent to Ensign, Nahma, and Summerville soils. Ensign soils are somewhat poorly drained and are slightly higher on the landscape than the Ruse soils. Nahma soils are underlain by limestone bedrock at a depth of 20 to 40 inches. They are in landscape positions similar to those of the Ruse soils. Summerville soils are well drained and are in the higher landscape positions.

Typical pedon of Ruse mucky loam, in an area of Nahma-Ruse complex, 1,600 feet south and 1,000 feet east of the northwest corner of sec. 23, T. 37 N., R. 27 W., Nadeau Township:

A—0 to 6 inches; black (N 2/0) mucky loam, dark brown (7.5YR 3/2) dry; weak medium subangular blocky structure; friable; many fine and medium and common coarse roots; neutral; clear wavy boundary.
Bw—6 to 12 inches; dark yellowish brown (10YR 4/4) loam; some very dark gray (N 3/0) material; weak fine subangular blocky structure; friable; few fine and medium roots; about 2 percent pebbles and cobbles; neutral; clear wavy boundary.
2C—12 to 18 inches; yellow (2.5Y 7/6) and yellowish brown (10YR 5/4) gravelly sandy loam; massive; friable; about 20 percent pebbles and cobbles; common white (10YR 8/1) accumulations of lime; slight effervescence; mildly alkaline; abrupt smooth boundary.
2R—18 inches; limestone bedrock.

The thickness of the solum and the depth to bedrock range from 10 to 20 inches. The content of pebbles and cobbles ranges from 0 to 20 percent throughout the profile.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly mucky loam, but the range includes mucky silt loam. Some pedons have an Oa horizon. The B horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 1 to 4. It is loam, sandy loam, or fine sandy loam.

Solona Series

The Solona series consists of deep, somewhat poorly drained, moderately permeable soils on ground moraines. These soils formed in calcareous, loamy glacial till. Slope is 0 to 3 percent.

Solona soils are similar to Banat soils and are commonly adjacent to Cathro, Ensley, and Onaway soils. Banat soils have more sand and gravel in the lower part of the subsoil and in the substratum than the Solona soils. The very poorly drained Cathro and poorly drained Ensley soils are lower on the landscape than the Solona soils. Cathro soils formed in organic material over loamy material. The well drained Onaway soils are higher on the landscape than the Solona soils.

Typical pedon of Solona loam, 0 to 3 percent slopes, about 2,500 feet east and 100 feet south of the northwest corner of sec. 36, T. 37 N., R. 26 W., Nadeau Township:

A—0 to 2 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many fine and medium and few coarse roots; about 2 percent pebbles and 1 percent cobbles; slightly acid; abrupt wavy boundary.
BA—2 to 7 inches; brown (7.5YR 4/4) loam (B) and black (10YR 2/1) loam (A); moderate fine subangular blocky structure; many fine and medium and few coarse roots; about 3 percent pebbles; neutral; clear wavy boundary.
Bt1—7 to 14 inches; brown (7.5YR 4/4) loam; moderate fine subangular blocky structure; friable; common thin reddish brown (5YR 4/4) clay films on faces of peds; common fine and medium roots; about 5 percent pebbles and 2 percent cobbles; mildly alkaline; clear wavy boundary.
Bt2—14 to 21 inches; yellowish red (5YR 4/6) loam; few fine distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; friable; common thin reddish brown (5YR 4/4) clay films on faces of peds; few fine roots; about 3 percent pebbles and 2 percent cobbles; mildly alkaline; clear wavy boundary.
BC—21 to 24 inches; brown (7.5YR 5/4) gravelly fine sandy loam; common fine distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; about 22 percent pebbles and 6 percent cobbles; mildly alkaline; clear wavy boundary.
C—24 to 60 inches; light brown (7.5YR 6/4) gravelly fine sandy loam; common fine distinct strong brown

(7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; about 22 percent pebbles and 6 percent cobbles; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. The content of pebbles ranges from 2 to 15 percent in the A and Bt horizons.

Some pedons have an Ap horizon. The A and Bt horizons are loam or fine sandy loam. The A horizon has hue of 2 or 3 and chroma of 1 or 2. The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 3 to 6. The 2C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. It is gravelly fine sandy loam or gravelly sandy loam.

Summerville Series

The Summerville series consists of shallow, well drained, moderately permeable soils on moraines and till plains. These soils formed in calcareous, loamy glacial till over limestone bedrock. Slope ranges from 0 to 12 percent.

Summerville soils are commonly adjacent to Cunard, Ensign, and Sundell soils. Cunard soils are underlain by bedrock at a depth of 20 to 40 inches. They are in landscape positions similar to those of the Summerville soils. Ensign and Sundell soils are somewhat poorly drained and are lower on the landscape than the Summerville soils.

Typical pedon of Summerville fine sandy loam, in an area of Summerville-Cunard fine sandy loams, 0 to 6 percent slopes, 2,000 feet south and 100 feet east of the northwest corner of sec. 27, T. 38 N., R. 27 W., Meyer Township:

Oi—1 inch to 0; light yellowish brown (10YR 6/4), undecomposed leaf litter; slightly acid; abrupt smooth boundary.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine and medium and common coarse roots; slightly acid; clear wavy boundary.

Bw1—2 to 9 inches; brown (7.5YR 4/4) fine sandy loam; moderate fine subangular blocky structure; friable; common medium and coarse and many fine roots; about 2 percent pebbles; slightly acid; clear wavy boundary.

Bw2—9 to 16 inches; dark brown (7.5YR 4/4) fine sandy loam; moderate fine subangular blocky structure; friable; common medium and coarse and many fine roots; very dark grayish brown (10YR 3/2) organic stains; about 2 percent pebbles and 1 percent cobbles; slightly acid; abrupt wavy boundary.

2R—16 inches; limestone bedrock.

The thickness of the solum and the depth to limestone range from 10 to 20 inches. The content of pebbles and cobbles is 0 to 5 percent in the solum.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes loam. Pedons in cultivated areas have an Ap horizon. Some pedons have an E horizon. The Bw horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5, and chroma of 4 to 6. It is typically fine sandy loam, but the range includes sandy loam and loam. Some pedons have a C horizon.

Sundell Series

The Sundell series consists of moderately deep, somewhat poorly drained, moderately permeable soils on till plains. These soils formed in calcareous, loamy glacial till over limestone bedrock. Slope is 0 to 3 percent.

Sundell soils are commonly adjacent to Cunard, Ensign, Nahma, and Summerville soils. Cunard and Summerville soils are well drained and are higher on the landscape than the Sundell soils. Ensign soils are underlain by limestone bedrock at a depth of 10 to 20 inches. Nahma soils are poorly drained and are lower on the landscape than the Sundell soils.

Typical pedon of Sundell loam, in an area of Sundell-Ensign loams, 0 to 3 percent slopes, 2,550 feet west and 2,600 feet south of the northeast corner of sec. 5, T. 38 N., R. 26 W., Spalding Township:

Oi—2 inches to 0; light yellowish brown (10YR 6/4), undecomposed forest litter; slightly acid; abrupt smooth boundary.

A—0 to 7 inches; black (N 2/0) loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; friable; few coarse and common fine and medium roots; about 3 percent pebbles and cobbles; neutral; clear wavy boundary.

B/A—7 to 11 inches; dark brown (7.5YR 4/4) loam (B); moderate medium subangular blocky structure parting to moderate fine granular; friable; tongues of very dark gray (N 3/0) loam (A); moderate fine granular structure; friable; common fine and medium and few coarse roots; many black (10YR 2/1) worm casts; about 2 percent pebbles and cobbles; mildly alkaline; clear irregular boundary.

Bw—11 to 18 inches; brown (7.5YR 4/4) fine sandy loam; few fine and medium distinct pinkish gray (7.5YR 7/2) and common fine and medium distinct strong brown (7.5YR 5/8) mottles; weak very thin platy structure; friable; common fine and few medium and coarse roots; common fine and medium very dark gray (10YR 3/1) worm casts; about 6 percent pebbles and cobbles; slight effervescence; moderately alkaline; clear wavy boundary.

C1—18 to 22 inches; brownish yellow (10YR 6/6) fine sandy loam; few medium distinct yellow (10YR 7/8) and few medium faint very pale brown (10YR 7/4) mottles; massive; friable; few fine roots; about 8 percent pebbles and cobbles; slight effervescence; moderately alkaline; abrupt wavy boundary.
C2—22 to 23 inches; yellowish red (5YR 5/6) fine sandy loam; massive breaking to weak very thin platy fragments; friable; few fine roots; about 7 percent pebbles and cobbles; slight effervescence; moderately alkaline; abrupt broken boundary.
R—23 inches; limestone.

The depth to limestone ranges from 20 to 40 inches. The content of pebbles and cobbles ranges from 1 to 15 percent in the solum.

The A horizon has hue of 5YR or 7.5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly loam, but the range includes fine sandy loam and sandy loam. The Bw horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 3 or 4. It is fine sandy loam, sandy loam, or loam. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam or sandy loam.

Tawas Series

The Tawas series consists of deep, very poorly drained, organic soils in depressional areas on moraines and lake plains. These soils formed in decomposed woody organic material 16 to 50 inches deep over sandy material. Permeability is moderately slow to moderately rapid in the organic material and rapid in the sandy material. Slope is 0 to 2 percent.

Tawas soils are similar to Cathro and Lupton soils and are commonly adjacent to Deford, Lupton, and Rousseau soils. Cathro soils are underlain by loamy material. Lupton soils are organic to a depth of more than 50 inches. Deford soils are poorly drained and are slightly higher on the landscape than the Tawas soils. They are dominantly sandy throughout. Rousseau soils are well drained and are in the higher landscape positions. They are sandy throughout.

Typical pedon of Tawas mucky peat, in an area of the Lupton-Tawas association, 1,300 feet north and 900 feet west of the southeast corner of sec. 31, T. 34 N., R. 27 W., Mellen Township:

Oe—0 to 4 inches; hemic material, black (5YR 2/1) broken face and rubbed; about 95 percent fiber, 35 percent rubbed; massive; very friable; many roots; medium acid; abrupt smooth boundary.
Oa1—4 to 12 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 40 percent fiber, less than 10 percent rubbed; weak very thick platy structure; very friable; few roots; medium acid; clear smooth boundary.
Oa2—12 to 22 inches; sapric material, black (5YR 2/1) broken face, dark reddish brown (5YR 2/2) rubbed; about 25 percent fiber, less than 10 percent rubbed; weak very fine subangular blocky structure; very friable; few roots; medium acid; abrupt smooth boundary.
Oa3—22 to 25 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 10 percent fiber, 1 percent rubbed; massive; very friable; medium acid; clear smooth boundary.
A—25 to 31 inches; black (10YR 2/1) mucky fine sand; massive; friable; medium acid; clear smooth boundary.
C—31 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; medium acid.

The depth to sandy material ranges from 16 to 50 inches. The organic material is primarily woody, but herbaceous layers are mixed throughout the organic layers in most pedons.

The surface tier has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has chroma of 0 to 2. The subsurface and bottom tiers have hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 to 3. Some pedons have a layer of hemic material as much as 10 inches thick. The C horizon has value of 4 to 6 and chroma of 1 or 2. It is sand, loamy sand, or fine sand.

Wainola Series

The Wainola series consists of deep, somewhat poorly drained, rapidly permeable soils on outwash plains and lake plains. These soils formed in sandy glaciolacustrine sediments. Slope is 0 to 3 percent.

Wainola soils are similar to Gladwin and Ingalls soils and are commonly adjacent to Deford, Gladwin, Rousseau, and Tawas soils. Gladwin soils have more pebbles and coarser sand in the substratum than the Wainola soils. Ingalls soils have more clay in the substratum than the Wainola soils. The poorly drained Deford and very poorly drained Tawas soils are in the lower landscape positions. Tawas soils formed in organic material over sandy material. The well drained Rousseau soils are in the higher positions.

Typical pedon of Wainola fine sand, in an area of Deford-Wainola-Rousseau complex, 0 to 12 percent slopes, 2,200 feet north and 200 feet west of the southeast corner of sec. 6, T. 34 N., R. 25 W., Ingallston Township:

Oa—2 inches to 0; black (N 2/0), well decomposed forest litter; weak fine granular structure; very friable; many fine and medium roots; strongly acid; abrupt wavy boundary.
E—0 to 10 inches; pinkish gray (7.5YR 6/2) fine sand; single grain; loose; common coarse and fine roots; strongly acid; abrupt wavy boundary.

Bs1—10 to 16 inches; reddish brown (5YR 4/4) fine sand; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very friable; few fine and medium roots; common dark reddish brown (5YR 3/4) weakly cemented ortstein fragments; very strongly acid; clear wavy boundary.

Bs2—16 to 25 inches; dark brown (7.5YR 4/4) fine sand; common fine faint strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very friable; few fine and medium roots; common dark brown (7.5YR 4/4) very weakly cemented ortstein fragments; very strongly acid; gradual wavy boundary.

BC—25 to 39 inches; brown (7.5YR 5/4) fine sand; common fine distinct reddish yellow (7.5YR 6/6) mottles; single grain; loose; few fine roots; strongly acid; clear wavy boundary.

C—39 to 60 inches; brown (7.5YR 5/2) very fine sand; single grain; loose; strongly acid.

The solum ranges from 20 to 42 inches in thickness. It is fine sand or loamy fine sand.

The Oa horizon is 2 to 4 inches thick. Some pedons have an A horizon. The E horizon has hue of 7.5YR or 10YR and value of 6 or 7. The Bs horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4, and chroma of 2 to 6. Some pedons have a discontinuous ortstein layer, which is 0 to 6 inches thick. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6, and chroma of 2 to 4. It is very fine sand or fine sand that in some pedons has thin strata of silt or silt loam.

Formation of the Soils

This section relates the factors of soil formation to the soils in Menominee County and explains the processes of soil formation.

Factors of Soil Formation

Soil forms through the interaction of five major factors—the physical, chemical, and mineral composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the parent material.

Climate and plant and animal life are the active forces of soil formation. They slowly change the parent material into a natural body of soil that has genetically related layers, called horizons. The effects of climate and plant and animal life are conditioned by relief. The nature of the parent material affects the kind of soil profile that forms. In extreme cases, it determines the soil profile almost entirely. Finally, time is needed for the differentiation of soil horizons.

The factors of soil formation are so closely related in their effects on the soils that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soil. The parent materials of the soils of Menominee County were deposited by glaciers or by meltwater from the glaciers that covered the county 10,000 to 12,000 years ago. Some of these parent materials have been reworked and redeposited by the subsequent action of water and wind. Although most of the parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Menominee County were deposited as glacial till, outwash, lacustrine material, organic material, and alluvium.

Glacial till was deposited directly by glaciers with a minimum of water action. It is a mixture of particles of different sizes. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water. The glacial till in Menominee County is calcareous and is dominantly gravelly fine sandy loam or loamy sand. Onaway soils are an example of soils that formed in glacial till. They typically are moderately coarse textured and have a well developed subsoil.

Outwash material was deposited by running water from melting glaciers. The size of the particles depends on the speed of the stream that carried material. When the water slowed down, the coarser particles were deposited. Finer particles, such as very fine sand, silt, and clay, were carried by slowly moving water. Outwash deposits generally occur as layers of particles of similar size, such as sand, gravel, and other coarse particles. Nadeau soils are an example of soils that formed in outwash material.

Lacustrine material was deposited from still, or ponded, glacial meltwater. Because the coarser particles were deposited as outwash by moving glacial meltwater, only the finer particles, such as very fine sand, silt, and clay, remained to settle out in still water. The soils in Menominee County that formed in lacustrine deposits typically are moderately fine textured and coarse textured. Pickford soils are an example.

Alluvium was recently deposited by floodwater along streams. It varies in texture, depending on the speed of the water from which it was deposited. Arnheim and Moquah soils formed in alluvium.

Organic material occurs as deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions on outwash plains, flood plains, moraines, and till plains. Grasses and sedges growing around the edges of these lakes died, and their residue fell to the bottom. Because the areas were wet, the plant remains did not decompose but remained around the edge of the lake. Later, water-tolerant trees grew in the areas. After these trees died, their residue became part of the organic accumulation. Eventually, the lakes were filled with organic material and developed into areas of muck. Lupton soils are an example of soils that formed in organic material.

Plant and Animal Life

Plants have affected the soils in Menominee County more significantly than the other living organisms. Bacteria, fungi, and earthworms, however, also have been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen

to the soil. The kind of organic matter on and in the soil depends on the kinds of native plants that grew on the soil. The remains of these plants accumulated on the surface, decayed, and eventually became organic matter. The roots of the plants provided channels for the downward movement of water through the soil and added organic matter as they decayed. Bacteria in the soil helped to break down the organic matter into plant nutrients.

The native vegetation in Menominee County was a mixture of coniferous and deciduous trees. Differences in natural soil drainage and parent material have affected the composition of the forest species. The well drained soils on uplands, such as Onaway and Nadeau soils, generally were covered by sugar maple, white ash, and basswood. The well drained or moderately well drained Rousseau soils were covered by hemlock and white pine. The very poorly drained Cathro and poorly drained Ensley soils were covered by northern white-cedar, black ash, and balsam fir.

Climate

Climate determines the kind of plant and animal life on and in the soil and the amount of water available for the weathering of minerals and the translocation of soil material. Through its influence on soil temperatures, climate also determines the rate of chemical reaction in the soil.

The climate in Menominee County is cool and humid. Presumably, it is similar to that under which the soils formed. The soils in Menominee County differ from the soils that formed under a dry, warm climate and from those that formed under a moist, hot climate. The climate is uniform throughout the county, but its effect is modified locally by the proximity to Lake Michigan. Only minor differences among the soils in the county are the result of differences in climate.

Relief

Relief has markedly affected the soils in Menominee County through its influence on natural drainage, runoff, erosion, plant cover, and soil temperature. Slopes range from 0 to 35 percent. Natural soil drainage ranges from excessively drained on hilltops to very poorly drained in depressions.

Through its effect on soil aeration, drainage influences the color of the soil. Runoff is most rapid on the steeper slopes. In some low areas, water is temporarily ponded. Water and air move freely through well drained soils but slowly through very poorly drained soils. In Pemene and other well aerated, well drained soils, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. Poorly aerated, poorly drained soils are dull gray and mottled. Pickford soils are an example.

Time

Generally, a long time is needed for the development of distinct horizons. Differences in length of time that the parent material has been in place are commonly reflected in the degree of profile development. Some soils form rapidly. Others form slowly.

The soils in Menominee County range from young to mature. Most of the soils that formed in glacial deposits have been exposed to the soil-forming processes long enough for the development of distinct horizons. Pemene soils are an example of these older soils. Arnheim soils are an example of young soils. They formed in recent alluvial sediments and have not been in place long enough for distinct horizons to develop.

Processes of Soil Formation

Several processes were involved in the development of horizons in the soils of Menominee County. These were the accumulation of organic matter, the leaching of lime (calcium carbonate) and other bases, the reduction and transfer of iron, and the formation and translocation of clay minerals. More than one of these processes have helped to differentiate horizons in most of the soils.

As organic matter accumulated at the surface, an A horizon formed. If the soil is plowed, the A horizon is mixed into a plow layer, or Ap horizon. The surface layer of the soils in Menominee County ranges from high to low in organic matter content. The content is high, for example, in Ensley soils and low in Rubicon soils.

The leaching of carbonates and other bases has occurred in most of the soils. The leaching of bases usually precedes the translocation of silicate clay minerals. Many of the soils are moderately leached or strongly leached. Onaway soils, for example, are leached to a depth of 15 to 30 inches, whereas Pemene soils are leached to a depth of 24 to 48 inches. Differences in the depth of leaching are the result of time and parent material.

Gleying, or the reduction and transfer of iron, is evident in somewhat poorly drained to very poorly drained soils. Pickford soils are an example. A gray color in the subsoil indicates the reduction and loss of iron.

The translocation of clay minerals has contributed to horizon development. An eluviated, or leached, E horizon is lower in content of clay and typically is lighter in color than the illuviated B horizon. The B horizon typically has an accumulation of clay (clay films) in pores and on the faces of peds. Soils in which clay has been translocated were probably leached of carbonates and soluble salts to a considerable extent before the translocation of clay took place. Onaway soils are an example of soils in which clay in the form of clay films has accumulated in the B horizon.

In some soils, such as Rousseau and Wainola soils, iron, aluminum, and humus have been transferred from

the A horizon to the B horizon. Because of this transfer, the B horizon is dark brown.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing

season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management

requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Dashes indicate data were not available. Data recorded at Stephenson in the period 1951-80 and at Cornell in the periods 1964-67 and 1971-80)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
STEPHENSON:											
January---	24.2	4.3	14.2	44	-26	0	1.72	0.9	2.4	5	15.1
February--	28.7	6.8	17.7	49	-23	0	1.33	.5	2.0	4	11.1
March-----	38.2	17.1	27.6	61	-15	1	2.14	1.1	3.0	6	12.7
April-----	54.0	30.6	42.3	83	8	37	2.67	1.6	3.6	6	4.2
May-------	67.0	40.3	53.7	89	21	179	3.57	2.3	4.8	7	.2
June------	75.9	49.5	62.7	93	30	391	3.72	2.0	5.2	7	.0
July------	80.5	54.3	67.4	94	37	547	3.63	2.3	4.9	7	.0
August----	78.2	52.8	65.5	93	35	488	3.86	2.2	5.3	7	.0
September-	68.9	45.2	57.1	88	25	240	3.59	1.9	5.1	7	Trace
October---	58.3	36.5	47.4	81	18	77	2.29	1.0	3.4	5	.2
November--	41.8	25.2	33.5	66	-1	4	2.06	1.1	2.9	6	6.2
December--	29.1	12.4	20.8	51	-19	0	2.05	1.1	2.9	6	15.6
Year----	53.7	31.2	42.5	96	-28	1,964	32.63	28.4	36.7	73	65.3
CORNELL:											
January---	24.5	4.2	14.3	46	-22	---	1.54	0.8	2.2	4	15.7
February--	27.6	5.5	16.6	52	-23	---	1.09	.4	1.7	4	11.4
March-----	37.6	16.0	26.8	59	-17	---	2.26	.8	3.5	5	11.8
April-----	51.6	27.6	39.6	78	4	---	2.44	1.6	3.2	6	3.2
May-------	66.3	38.2	52.3	89	20	---	3.67	2.1	5.0	7	.8
June------	74.7	47.2	61.0	91	29	---	3.74	2.2	5.1	8	.0
July------	79.8	52.3	66.1	94	34	---	3.53	1.7	5.1	7	.0
August----	76.2	51.0	63.6	92	31	---	4.67	3.1	6.1	8	.0
September-	67.7	43.8	55.7	88	24	---	3.68	1.9	5.3	7	.0
October---	56.4	35.2	45.8	78	15	---	2.44	1.0	3.7	5	Trace
November--	41.0	24.5	32.7	66	-1	---	2.24	1.2	3.2	5	5.0
December--	28.9	12.3	20.6	46	-19	---	1.50	.9	2.1	5	13.8
Year----	52.7	29.8	41.3	95	-26	---	32.80	28.4	37.1	71	61.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--PRECIPITATION

(Recorded in the period 1953-80 at Spalding)

Month	Precipitation				
	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
		Less than--	More than--		
	In	In	In		In
January-----	1.30	0.6	1.8	4	14.8
February----	.96	.3	1.5	4	11.3
March-------	1.73	.8	2.6	4	11.7
April-------	2.66	1.7	3.6	6	4.5
May---------	3.52	2.2	4.6	7	.6
June--------	3.41	2.1	4.6	7	.0
July--------	3.30	2.0	4.5	6	.0
August------	3.72	2.0	5.2	7	.0
September---	3.53	2.0	4.9	7	Trace
October-----	2.36	1.1	3.4	5	.6
November----	1.97	1.1	2.7	5	6.6
December----	1.68	.8	2.3	5	15.9
Year------	30.14	26.0	34.2	67	66.0

TABLE 3.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1949-79 at Stephenson)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 16	May 30	June 15
2 years in 10 later than--	May 11	May 25	June 10
5 years in 10 later than--	May 1	May 16	May 30
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 28	Sept. 16	Sept. 5
2 years in 10 earlier than--	Oct. 4	Sept. 20	Sept. 9
5 years in 10 earlier than--	Oct. 16	Sept. 28	Sept. 18

TABLE 4.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1930-79)

Probability	Temperature					
	24° F or lower		28° F or lower		32° F or lower	
	Inland at Iron Mt.	Shoreline at Escanaba	Inland at Iron Mt.	Shoreline at Escanaba	Inland at Iron Mt.	Shoreline at Escanaba
Last freezing temperature in spring:						
1 year in 10 later than--	May 19	Apr. 27	May 30	May 9	June 12	May 22
2 years in 10 later than--	May 14	Apr. 22	May 25	May 4	June 7	May 18
5 years in 10 later than--	May 5	Apr. 13	May 16	May 3	May 29	May 10
First freezing temperature in fall:						
1 year in 10 earlier than--	Sept. 20	Oct. 23	Sept. 11	Oct. 8	Sept. 4	Sept. 20
2 years in 10 earlier than--	Sept. 26	Oct. 28	Sept. 16	Oct. 14	Sept. 8	Sept. 26
5 years in 10 earlier than--	Oct. 8	Nov. 6	Sept. 26	Oct. 26	Sept. 17	Oct. 8

TABLE 5.--GROWING SEASON

(Recorded in the period 1949-79 at Stephenson)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	144	114	89
8 years in 10	152	121	96
5 years in 10	167	134	110
2 years in 10	182	148	123
1 year in 10	190	155	130

TABLE 6.--GROWING SEASON

Probability	Daily minimum temperature during growing season					
	Higher than 24° F		Higher than 28° F		Higher than 32° F	
	Inland at Iron Mt.	Shoreline at Escanaba	Inland at Iron Mt.	Shoreline at Escanaba	Inland at Iron Mt.	Shoreline at Escanaba
	Days	Days	Days	Days	Days	Days
9 years in 10	131	186	110	160	91	129
8 years in 10	140	193	118	168	98	136
5 years in 10	156	206	133	183	111	150
2 years in 10	172	219	148	198	124	164
1 year in 10	181	226	156	205	130	171

TABLE 7.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
10B	Onaway fine sandy loam, 3 to 9 percent slopes	139,723	20.9
10D	Onaway fine sandy loam, 12 to 35 percent slopes	12,474	1.9
11B	Posen cobbly fine sandy loam, 3 to 12 percent slopes, very stony	3,186	0.5
12B	Nadeau fine sandy loam, 3 to 12 percent slopes	17,574	2.6
12D	Nadeau fine sandy loam, 15 to 35 percent slopes	3,525	0.5
14	Minocqua-Tawas complex	6,536	1.0
15A	Gladwin loamy sand, 0 to 3 percent slopes	2,444	0.4
16	Ensley mucky silt loam	10,615	1.6
17	Cathro-Ensley complex	47,815	7.1
18	Lupton-Cathro association	88,471	13.2
19	Loxley-Dawson association	8,469	1.3
20A	Solona loam, 0 to 3 percent slopes	15,949	2.4
21	Deford mucky fine sand	10,144	1.5
22A	Wainola fine sand, 0 to 3 percent slopes	6,579	1.0
23B	Rousseau fine sand, 3 to 12 percent slopes	6,489	1.0
23D	Rousseau fine sand, 15 to 25 percent slopes	802	0.1
24	Arnheim-Moquah complex, 0 to 3 percent slopes	7,805	1.2
25B	Onaway-Rousseau complex, 3 to 12 percent slopes	15,108	2.3
26B	Rubicon sand, 3 to 12 percent slopes	4,804	0.7
27A	Urban land-Rousseau complex, 0 to 3 percent slopes	702	0.1
28A	Ingalls fine sand, 0 to 3 percent slopes	2,939	0.4
29	Burleigh mucky fine sand	2,515	0.4
30B	Cunard-Onaway fine sandy loams, 0 to 6 percent slopes	10,339	1.5
32A	Sundell-Ensign loams, 0 to 3 percent slopes	3,917	0.6
33	Nahma-Ruse complex	2,863	0.4
34	Urban land-Deford complex	976	0.1
35	Lupton-Tawas association	59,845	8.9
36	Chippeny-Nahma mucks	3,743	0.6
37B	Mancelona-Nadeau complex, 0 to 8 percent slopes	6,540	1.0
38A	Rousseau fine sand, 0 to 3 percent slopes	4,016	0.6
40	Lupton muck, ponded	3,127	0.5
41	Aquents, sandy and loamy	754	0.1
42	Pits, sand and gravel	863	0.1
44	Tawas-Deford complex	18,721	2.8
45C	Deford-Wainola-Rousseau complex, 0 to 12 percent slopes	32,559	4.9
46	Pickford mucky silty clay loam	1,873	0.3
49C	Cathro-Solona-Onaway complex, 0 to 15 percent slopes	9,165	1.4
50B	Grayling sand, 3 to 12 percent slopes	4,249	0.6
51B	Pemene-Rubicon complex, 3 to 12 percent slopes	18,803	2.8
52B	Onaway-Nadeau fine sandy loams, 3 to 12 percent slopes	12,651	1.9
52D	Onaway-Nadeau fine sandy loams, 12 to 35 percent slopes	1,231	0.2
53B	Pemene-Rousseau-Rock outcrop complex, 3 to 12 percent slopes	963	0.1
54C	Tawas-Banat-Nadeau complex, 0 to 15 percent slopes	4,179	0.6
55B	Nadeau-Summerville fine sandy loams, 3 to 12 percent slopes	803	0.1
56A	Amasa very fine sandy loam, 0 to 3 percent slopes	522	0.1
58A	Banat silt loam, 0 to 3 percent slopes	2,073	0.3
59B	Nahma-Sundell-Summerville complex, 0 to 6 percent slopes	8,515	1.3
60B	Onaway-Solona complex, 0 to 10 percent slopes	20,069	3.0
61B	Pemene-Nadeau complex, 3 to 12 percent slopes	1,213	0.2
62B	Summerville-Cunard fine sandy loams, 0 to 6 percent slopes	7,838	1.2
63B	Bowers-Ingalls complex, 0 to 6 percent slopes	571	0.1
64A	Solona-Ingalls complex, 0 to 2 percent slopes	1,388	0.2
66B	Johnswood-Detour complex, 2 to 6 percent slopes, very stony	1,343	0.2
67B	Pemene fine sandy loam, 3 to 12 percent slopes	3,390	0.5
67D	Pemene fine sandy loam, 15 to 35 percent slopes	385	0.1
68B	Cunard-Sundell complex, 0 to 8 percent slopes	885	0.1
69B	Onaway-Rousseau-Solona complex, 0 to 12 percent slopes	1,643	0.2
	Water areas less than 40 acres in size	2,296	0.3
	Total	668,979	100.0

TABLE 8.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
10B	Onaway fine sandy loam, 3 to 9 percent slopes
16	Ensley mucky silt loam (where drained)
20A	Solona loam, 0 to 3 percent slopes (where drained)
28A	Ingalls fine sand, 0 to 3 percent slopes (where drained)
56A	Amasa very fine sandy loam, 0 to 3 percent slopes
60B	Onaway-Solona complex, 0 to 10 percent slopes
63B	Bowers-Ingalls complex, 0 to 6 percent slopes (where drained)
64A	Solona-Ingalls complex, 0 to 2 percent slopes (where drained)

TABLE 9.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Barley	Alfalfa hay	Grass hay
		Bu	Tons	Bu	Bu	Tons	Tons
10B---------- Onaway	IIIe	90	14	65	65	4.5	---
10D---------- Onaway	VIe	---	---	---	---	3.5	---
11B---------- Posen	VIs	---	---	---	---	---	---
12B---------- Nadeau	IVe	70	8	50	50	2.8	---
12D---------- Nadeau	VIIe	---	---	---	---	---	---
14---------- Minocqua-Tawas	VIw	---	---	---	---	---	---
15A---------- Gladwin	IIIw	60	12	50	50	2.8	---
16---------- Ensley	Vw	---	---	---	---	---	---
17---------- Cathro-Ensley	VIw	---	---	---	---	---	---
18*:							
Lupton---------	Vw	---	---	---	---	---	---
Cathro---------	VIw	---	---	---	---	---	---
19*:							
Loxley---------	VIIw	---	---	---	---	---	---
Dawson---------	VIIw	---	---	---	---	---	---
20A---------- Solona	IIw	55	14	40	40	3.5	---
21---------- Deford	Vw	---	---	---	---	---	---
22A---------- Wainola	IIIw	60	12	50	---	3.0	---
23B---------- Rousseau	IIIe	45	9	35	35	2.5	2.0
23D---------- Rousseau	VIe	---	---	---	---	---	1.8
24---------- Arnheim-Moquah	Vw	---	---	---	---	---	---
25B---------- Onaway-Rousseau	IIIe	68	12	54	55	3.4	---

See footnote at end of table.

TABLE 9.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Barley	Alfalfa hay	Grass hay
		Bu	Tons	Bu	Bu	Tons	Tons
26B---------- Rubicon	VIs	---	---	---	---	---	1.6
27A. Urban land-Rousseau							
28A---------- Ingalls	IIIw	60	14	40	40	2.8	---
29---------- Burleigh	Vw	---	---	---	---	---	---
30B---------- Cunard-Onaway	IIIe	70	11	60	60	4.0	---
32A---------- Sundell-Ensign	Vw	---	---	---	---	---	---
33---------- Nahma-Ruse	VIw	---	---	---	---	---	---
34. Urban land-Deford							
35*:							
Lupton---------	Vw	---	---	---	---	---	---
Tawas----------	VIw	---	---	---	---	---	---
36---------- Chippeny-Nahma	VIw	---	---	---	---	---	---
37B---------- Mancelona-Nadeau	IIIs	60	9	50	50	3.0	---
38A---------- Rousseau	IIIs	50	8	40	40	3.0	2.0
40---------- Lupton	VIIIw	---	---	---	---	---	---
41. Aquents							
42*. Pits							
44---------- Tawas-Deford	VIw	---	---	---	---	---	---
45C---------- Deford-Wainola-Rousseau	Vw	---	---	---	---	---	---
46---------- Pickford	Vw	---	---	---	---	---	---

See footnote at end of table.

TABLE 9.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Barley	Alfalfa hay	Grass hay
		Bu	Tons	Bu	Bu	Tons	Tons
49C---Cathro-Solona-Onaway	VIw	---	---	---	---	---	---
50B---Grayling	VIs	---	---	---	---	---	1.6
51B---Pemene-Rubicon	IVe	---	---	50	45	2.6	---
52B---Onaway-Nadeau	IIIe	74	12	60	60	3.4	---
52D---Onaway-Nadeau	VIe	---	---	---	---	---	---
53B*---Pemene-Rousseau-Rock outcrop	VIe	---	---	---	---	---	---
54C---Tawas-Banat-Nadeau	VIw	---	---	---	---	---	---
55B---Nadeau-Summerville	IVe	---	---	---	---	---	---
56A---Amasa	IIs	---	---	65	---	3.2	---
58A---Banat	IIIw	75	12	60	60	3.2	---
59B---Nahma-Sundell-Summerville	Vw	---	---	---	---	---	---
60B---Onaway-Solona	IIIe	81	14	68	65	4.0	---
61B---Pemene-Nadeau	IIIe	60	9	54	54	3.0	---
62B---Summerville-Cunard	VIs	---	---	---	---	---	---
63B---Bowers-Ingalls	IIw	60	9	40	40	2.8	---
64A---Solona-Ingalls	IIw	60	9	50	50	3.6	---
66B---Johnswood-Detour	VIs	---	---	---	---	---	---
67B---Pemene	IIIe	75	10	55	50	3.0	---

See footnote at end of table.

TABLE 9.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Barley	Alfalfa hay	Grass hay
		Bu	Tons	Bu	Bu	Tons	Tons
67D---------- Pemene	VIIe	---	---	---	---	---	---
68B---------- Cunard-Sundell	IIIe	80	11	55	55	3.0	---
69B---------- Onaway-Rousseau-Solona	IIIe	70	11	58	58	4.0	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--CAPABILITY CLASSES AND SUBCLASSES

(Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	---	---	---	---
II	18,430	---	17,908	522
III	227,084	202,493	14,035	10,556
IV	43,669	43,669	---	---
V	161,265	---	161,265	---
VI	194,906	15,470	151,480	27,956
VII	14,907	6,438	8,469	---
VIII	3,127	---	3,127	---

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
10B---------- Onaway	3A	Slight	Slight	Slight	Slight	Sugar maple--------- Quaking aspen------- Balsam fir---------- American beech------ Paper birch--------- American basswood--- White ash----------	65 --- --- --- --- 65 ---	40 --- --- --- --- 59 ---	White spruce, Norway spruce, red pine.
10D---------- Onaway	3R	Moderate	Moderate	Slight	Slight	Sugar maple--------- Quaking aspen------- Balsam fir---------- American beech------ Paper birch--------- American basswood--- White ash----------	65 --- --- --- --- 65 ---	40 --- --- --- --- 59 ---	White spruce, Norway spruce, red pine.
11B---------- Posen	3X	Slight	Moderate	Slight	Moderate	Sugar maple--------- Quaking aspen------- Balsam fir---------- American basswood--- White ash---------- American beech------	62 --- --- --- --- ---	39 --- --- --- --- ---	White spruce, eastern white pine, red pine.
12B---------- Nadeau	2S	Slight	Slight	Slight	Moderate	Sugar maple--------- Quaking aspen------- Bigtooth aspen------ Northern red oak---- Eastern white pine-- White ash----------	55 --- 63 65 --- ---	35 --- 70 59 --- ---	Red pine, eastern white pine.
12D---------- Nadeau	2R	Moderate	Moderate	Slight	Moderate	Sugar maple--------- Quaking aspen------- Bigtooth aspen------ Northern red oak---- Eastern white pine-- White ash----------	55 --- 63 65 --- ---	35 --- 70 59 --- ---	Red pine, eastern white pine.
14**:									
Minocqua-------	7W	Slight	Severe	Severe	Severe	Balsam fir---------- Red maple---------- Balsam poplar------- Black ash---------- Tamarack---------- Northern white-cedar Quaking aspen-------	54 55 --- --- 55 --- ---	105 35 --- --- 50 --- ---	
Tawas----------	5W	Slight	Severe	Severe	Severe	Balsam fir---------- Northern white-cedar Quaking aspen------- Black ash---------- Tamarack----------	40 --- --- --- ---	71 --- --- --- ---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
15A---------- Gladwin	4W	Slight	Moderate	Slight	Moderate	Quaking aspen-------	60	64	White spruce, eastern white pine.
						Eastern hemlock-----	---	---	
						Eastern white pine--	53	99	
						Red maple----------	56	36	
						Bigtooth aspen------	60	64	
						Balsam fir----------	53	102	
						Paper birch---------	55	57	
						White spruce--------	53	103	
16---------- Ensley	3W	Slight	Severe	Severe	Severe	Red maple----------	62	39	
						Balsam fir----------	60	118	
						White spruce--------	---	---	
						Northern white-cedar	---	---	
						Black ash-----------	---	---	
						Balsam poplar-------	---	---	
17**:									
Cathro---------	5W	Slight	Severe	Severe	Severe	Balsam fir----------	40	71	
						Northern white-cedar	15	20	
						Tamarack------------	35	23	
						Paper birch---------	---	---	
						Black ash-----------	---	---	
						Black spruce--------	15	23	
						Balsam poplar-------	---	---	
Ensley---------	3W	Slight	Severe	Severe	Severe	Red maple----------	62	39	
						Balsam fir----------	60	118	
						White spruce--------	---	---	
						Northern white-cedar	---	---	
						Black ash-----------	---	---	
						Balsam poplar-------	---	---	
18**:									
Lupton---------	2W	Slight	Severe	Severe	Severe	Black spruce--------	20	29	
						Balsam fir----------	46	86	
						Black ash-----------	---	---	
						Northern white-cedar	---	---	
						Paper birch---------	---	---	
						Tamarack------------	---	---	
Cathro---------	5W	Slight	Severe	Severe	Severe	Balsam fir----------	40	71	
						Northern white-cedar	15	20	
						Tamarack------------	35	23	
						Paper birch---------	---	---	
						Black ash-----------	---	---	
						Black spruce--------	15	23	
						Balsam poplar-------	---	---	
19**:									
Loxley---------	2W	Slight	Severe	Severe	Severe	Black spruce--------	15	23	
						Tamarack------------	---	---	
Dawson---------	2W	Slight	Severe	Severe	Severe	Black spruce--------	15	23	
						Tamarack------------	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
20A---------- Solona	3W	Slight	Severe	Slight	Moderate	Sugar maple---------	64	40	White ash, white spruce, Norway spruce.
						Red maple----------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Bigtooth aspen------	---	---	
21---------- Deford	4W	Slight	Severe	Severe	Severe	Quaking aspen-------	60	64	
						Balsam fir----------	---	---	
						Northern white-cedar	---	---	
						Balsam poplar-------	---	---	
						Red maple----------	---	---	
						Black ash----------	---	---	
22A---------- Wainola	6W	Slight	Moderate	Slight	Moderate	Quaking aspen-------	70	81	White spruce, Norway spruce, eastern white pine.
						Paper birch---------	---	---	
						Red maple----------	55	35	
						Balsam fir----------	---	---	
						Eastern white pine--	---	---	
						Balsam poplar-------	---	---	
23B---------- Rousseau	5S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	65	73	Red pine, jack pine.
						Red maple----------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Eastern hemlock-----	---	---	
						Red pine-----------	---	---	
						Paper birch---------	65	73	
						Bigtooth aspen------	---	---	
23D---------- Rousseau	5R	Moderate	Moderate	Moderate	Slight	Quaking aspen-------	65	73	Red pine, jack pine.
						Red maple----------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Eastern white pine--	---	---	
						Red pine-----------	---	---	
						Paper birch---------	65	73	
						Bigtooth aspen------	---	---	
24**:									
Arnheim--------	5W	Slight	Severe	Moderate	Severe	White spruce--------	38	68	
						Northern white-cedar	---	---	
						Red maple----------	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						American elm--------	---	---	
						Quaking aspen-------	---	---	
						Tamarack-----------	---	---	
Moquah---------	3A	Slight	Slight	Slight	Slight	Northern red oak----	55	42	Red pine, white spruce.
						American basswood---	---	---	
						Red maple----------	---	---	
						White ash----------	---	---	
						White spruce--------	---	---	
						Eastern white pine--	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
25B**:									
Onaway	3A	Slight	Slight	Slight	Slight	Sugar maple	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						American beech	---	---	
						Paper birch	---	---	
						Red pine	---	---	
						American basswood	65	59	
						White ash	---	---	
Rousseau	5S	Slight	Moderate	Moderate	Slight	Quaking aspen	65	73	Red pine, jack pine.
						Red maple	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
						Red pine	---	---	
						Paper birch	65	73	
						Bigtooth aspen	---	---	
26B---------- Rubicon	4S	Slight	Moderate	Moderate	Slight	Quaking aspen	60	64	Red pine, jack pine.
						Jack pine	53	73	
						Red pine	50	75	
						Bigtooth aspen	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Red maple	---	---	
						Paper birch	---	---	
						Eastern white pine	45	75	
28A---------- Ingalls	4W	Slight	Moderate	Slight	Moderate	Quaking aspen	60	64	Eastern white pine, white spruce.
						Red maple	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						Paper birch	---	---	
						Bigtooth aspen	---	---	
29---------- Burleigh	2W	Slight	Severe	Severe	Severe	Quaking aspen	40	22	
						Bigtooth aspen	---	---	
						Black ash	---	---	
						Red maple	---	---	
						Balsam poplar	---	---	
						Northern white-cedar	---	---	
30B**:									
Cunard	3A	Slight	Slight	Slight	Moderate	Sugar maple	60	38	Red pine, white spruce.
						American basswood	---	---	
						American beech	---	---	
						White ash	---	---	
						Northern red oak	---	---	
						Bigtooth aspen	---	---	
Onaway	3A	Slight	Slight	Slight	Slight	Sugar maple	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						American beech	---	---	
						Paper birch	---	---	
						American basswood	65	59	
						White ash	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
32A**:									
Sundell	2W	Slight	Severe	Slight	Moderate	Red maple	55	35	White spruce, Norway spruce.
						Paper birch	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Northern white-cedar	---	---	
						Balsam poplar	---	---	
Ensign	2W	Slight	Severe	Moderate	Severe	Sugar maple	53	34	Eastern white pine, white spruce.
						Quaking aspen	---	---	
						Bigtooth aspen	---	---	
						Balsam fir	---	---	
						Northern white-cedar	---	---	
						Paper birch	---	---	
33**:									
Nahma	4W	Slight	Severe	Severe	Severe	Balsam fir	35	60	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Northern white-cedar	---	---	
						Black ash	---	---	
						Red maple	---	---	
						Balsam poplar	---	---	
Ruse	5W	Slight	Severe	Severe	Severe	Balsam fir	40	71	
						Black spruce	---	---	
						Northern white-cedar	---	---	
						Black ash	---	---	
						Paper birch	---	---	
						Quaking aspen	---	---	
35**:									
Lupton	2W	Slight	Severe	Severe	Severe	Black spruce	20	29	
						Balsam fir	46	86	
						Black ash	---	---	
						Northern white-cedar	---	---	
						Paper birch	---	---	
						Tamarack	---	---	
Tawas	5W	Slight	Severe	Severe	Severe	Balsam fir	40	71	
						Northern white-cedar	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
						Tamarack	---	---	
36**:									
Chippeny	4W	Slight	Severe	Severe	Severe	Balsam fir	35	60	
						Black ash	---	---	
						Paper birch	---	---	
						Northern white-cedar	---	---	
						Tamarack	---	---	
						Black spruce	---	---	
						Balsam poplar	---	---	
						Quaking aspen	---	---	
Nahma	4W	Slight	Severe	Severe	Severe	Balsam fir	35	60	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Northern white-cedar	---	---	
						Black ash	---	---	
						Red maple	---	---	
						Balsam poplar	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
37B**:									
Mancelona	3S	Slight	Slight	Moderate	Slight	Sugar maple	58	37	Red pine, eastern white pine.
						Northern red oak	---	---	
						Red pine	---	---	
						Paper birch	---	---	
						Eastern white pine	---	---	
						Quaking aspen	---	---	
Nadeau	2S	Slight	Slight	Slight	Moderate	Sugar maple	55	35	Red pine, eastern white pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
38A	5S	Slight	Moderate	Severe	Slight	Quaking aspen	65	73	Red pine, jack pine.
Rousseau						Red maple	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
						Red pine	---	---	
						Paper birch	65	73	
						Bigtooth aspen	---	---	
44**:									
Tawas	5W	Slight	Severe	Severe	Severe	Balsam fir	40	71	
						Northern white-cedar	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
						Tamarack	---	---	
Deford	4W	Slight	Severe	Severe	Severe	Quaking aspen	60	64	
						Balsam fir	---	---	
						Northern white-cedar	---	---	
						Balsam poplar	---	---	
						Red maple	---	---	
						Black ash	---	---	
45C**:									
Deford	4W	Slight	Severe	Severe	Severe	Quaking aspen	60	64	
						Balsam fir	---	---	
						Northern white-cedar	---	---	
						Balsam poplar	---	---	
						Red maple	---	---	
						Black ash	---	---	
Wainola	6W	Slight	Moderate	Slight	Moderate	Quaking aspen	70	81	White spruce, Norway spruce.
						Paper birch	---	---	
						Red maple	55	35	
						Balsam fir	---	---	
						Eastern white pine	---	---	
						Balsam poplar	---	---	
Rousseau	5S	Slight	Moderate	Moderate	Slight	Quaking aspen	65	5	Red pine, jack pine.
						Red maple	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
						Red pine	---	---	
						Paper birch	65	73	
						Bigtooth aspen	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
46---------- Pickford	6W	Slight	Severe	Severe	Severe	White spruce--------	45	84	
						Balsam fir----------	45	83	
						Paper birch---------	---	---	
						Quaking aspen-------	---	---	
						Northern white-cedar	---	---	
						Red maple-----------	---	---	
						Black spruce--------	---	---	
49C**:									
Cathro---------	5W	Slight	Severe	Severe	Severe	Balsam fir----------	40	71	
						Northern white-cedar	15	20	
						Tamarack------------	35	23	
						Paper birch---------	---	---	
						Black ash-----------	---	---	
						Black spruce--------	15	23	
						Balsam poplar-------	---	---	
Solona---------	3W	Slight	Severe	Slight	Moderate	Sugar maple---------	64	40	White spruce, Norway spruce.
						Red maple-----------	---	---	
						White ash-----------	---	---	
						Balsam poplar-------	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Quaking aspen-------	---	---	
Onaway---------	3A	Slight	Slight	Slight	Slight	Sugar maple---------	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen-------	---	---	
						Balsam fir----------	---	---	
						American beech------	---	---	
						Paper birch---------	---	---	
						American basswood---	65	59	
						White ash-----------	---	---	
50B---------- Grayling	4S	Slight	Moderate	Severe	Slight	Jack pine-----------	48	70	Jack pine, red pine.
						Northern red oak----	43	26	
						Red pine------------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	---	---	
51B**:									
Pemene---------	4S	Slight	Slight	Moderate	Slight	Northern red oak----	65	59	Red pine, white spruce, Norway spruce.
						Red maple-----------	---	---	
						Sugar maple---------	60	38	
						Paper birch---------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						Eastern white pine--	---	---	
						Red pine------------	---	---	
						Balsam fir----------	---	---	
Rubicon--------	4S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	60	64	Red pine, jack pine.
						Jack pine-----------	53	73	
						Red pine------------	50	75	
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	45	75	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
52B**:									
Onaway	3A	Slight	Slight	Slight	Slight	Sugar maple	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						American beech	---	---	
						Paper birch	---	---	
						American basswood	65	59	
						White ash	---	---	
Nadeau	2S	Slight	Slight	Slight	Moderate	Sugar maple	55	35	Red pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
52D**:									
Onaway	3R	Moderate	Moderate	Slight	Slight	Sugar maple	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						American beech	---	---	
						Paper birch	---	---	
						American basswood	65	59	
						White ash	---	---	
Nadeau	2R	Moderate	Moderate	Slight	Moderate	Sugar maple	55	35	Red pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
53B**:									
Pemene	4S	Slight	Slight	Moderate	Slight	Northern red oak	65	59	Red pine, white spruce, Norway spruce.
						Red maple	---	---	
						Sugar maple	60	38	
						Paper birch	---	---	
						Quaking aspen	---	---	
						Bigtooth aspen	---	---	
						Eastern white pine	---	---	
						Red pine	---	---	
						Balsam fir	---	---	
Rousseau	5S	Slight	Moderate	Moderate	Slight	Quaking aspen	65	73	Red pine, jack pine.
						Red maple	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
						Red pine	---	---	
						Paper birch	65	73	
						Bigtooth aspen	---	---	
Rock outcrop.									
54C**:									
Tawas	5W	Slight	Severe	Severe	Severe	Balsam fir	40	71	
						Northern white-cedar	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
						Tamarack	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
54C**:									
Banat	2W	Slight	Severe	Slight	Moderate	Sugar maple	54	34	White spruce, Norway spruce.
						Red maple	---	---	
						Paper birch	---	---	
						Eastern white pine	---	---	
						Northern white-cedar	---	---	
						White spruce	---	---	
						Eastern hemlock	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
Nadeau	2S	Slight	Slight	Slight	Moderate	Sugar maple	55	35	Red pine, eastern white pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
55B**:									
Nadeau	2S	Slight	Slight	Slight	Moderate	Sugar maple	55	35	Red pine, eastern white pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
Summerville	3D	Slight	Slight	Moderate	Severe	Sugar maple	61	38	White spruce, Norway spruce.
						Paper birch	53	53	
						American beech	---	---	
						Quaking aspen	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						White ash	---	---	
						Eastern white pine	---	---	
56A Amasa	3A	Slight	Slight	Slight	Slight	Sugar maple	62	39	Red pine, white spruce.
						Quaking aspen	70	81	
						Paper birch	---	---	
						Eastern hemlock	---	---	
						Balsam fir	---	---	
						Red maple	---	---	
58A Banat	2W	Slight	Severe	Slight	Moderate	Sugar maple	54	34	White spruce, Norway spruce.
						Red maple	---	---	
						Paper birch	---	---	
						Eastern white pine	---	---	
						Northern white-cedar	---	---	
						White spruce	---	---	
						Eastern hemlock	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
59B**:									
Nahma	4W	Slight	Severe	Severe	Severe	Balsam fir	35	60	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Northern white-cedar	---	---	
						Black ash	---	---	
						Red maple	---	---	
						Balsam poplar	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
59B**:									
Sundell	2W	Slight	Severe	Slight	Moderate	Red maple	55	35	White spruce, Norway spruce.
						Paper birch	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Northern white-cedar	---	---	
						Balsam poplar	---	---	
Summerville	3D	Slight	Slight	Moderate	Severe	Sugar maple	61	38	White spruce, Norway spruce.
						Paper birch	53	53	
						American beech	---	---	
						Quaking aspen	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						White ash	---	---	
						Eastern white pine	---	---	
						American basswood	---	---	
60B**:									
Onaway	3A	Slight	Slight	Slight	Slight	Sugar maple	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						American beech	---	---	
						Paper birch	---	---	
						American basswood	65	59	
						White ash	---	---	
Solona	3W	Slight	Severe	Slight	Moderate	Sugar maple	64	40	White spruce, Norway spruce.
						Red maple	---	---	
						White ash	---	---	
						American basswood	---	---	
						Balsam fir	---	---	
						Paper birch	---	---	
						Quaking aspen	---	---	
61B**:									
Pemene	4S	Slight	Slight	Moderate	Slight	Northern red oak	65	59	Red pine, white spruce, Norway spruce.
						Red maple	---	---	
						Sugar maple	60	38	
						Paper birch	---	---	
						Quaking aspen	---	---	
						Bigtooth aspen	---	---	
						Eastern white pine	---	---	
						Red pine	---	---	
						Balsam fir	---	---	
Nadeau	2S	Slight	Slight	Slight	Moderate	Sugar maple	55	35	Red pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
62B**:									
Summerville	3D	Slight	Slight	Moderate	Severe	Sugar maple	61	38	White spruce, Norway spruce.
						Paper birch	53	53	
						American beech	---	---	
						Quaking aspen	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						White ash	---	---	
						Eastern white pine	---	---	
						American basswood	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
62B**:									
Cunard	3A	Slight	Moderate	Slight	Moderate	Sugar maple	60	38	Red pine, white spruce.
						American basswood	---	---	
						American beech	---	---	
						White ash	---	---	
						Northern red oak	---	---	
						Bigtooth aspen	---	---	
63B**:									
Bowers	7W	Slight	Severe	Slight	Moderate	Balsam fir	54	105	White spruce, Norway spruce.
						American basswood	---	---	
						White ash	---	---	
						Quaking aspen	---	---	
						Sugar maple	---	---	
Ingalls	4W	Slight	Moderate	Slight	Moderate	Quaking aspen	60	64	Eastern white pine, white spruce.
						Red maple	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						Paper birch	---	---	
						Bigtooth aspen	---	---	
64A**:									
Solona	3W	Slight	Severe	Slight	Moderate	Sugar maple	64	40	White spruce, Norway spruce.
						Red maple	---	---	
						White ash	---	---	
						American basswood	---	---	
						Balsam fir	---	---	
						Paper birch	---	---	
						Quaking aspen	---	---	
Ingalls	4W	Slight	Moderate	Slight	Moderate	Quaking aspen	60	64	Eastern white pine, white spruce.
						Red maple	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						Paper birch	---	---	
						Bigtooth aspen	---	---	
66B**:									
Johnswood	3F	Slight	Moderate	Moderate	Severe	Sugar maple	65	40	Red pine, white spruce, Norway spruce.
						American beech	---	---	
						Balsam fir	---	---	
						American basswood	---	---	
						Paper birch	---	---	
						Northern white-cedar	---	---	
						White ash	---	---	
						Eastern hemlock	---	---	
Detour	7W	Slight	Severe	Slight	Severe	Balsam fir	50	96	White spruce, eastern white pine.
						Northern white-cedar	---	---	
						Quaking aspen	---	---	
						Black spruce	---	---	
						Paper birch	---	---	
						American beech	---	---	

See footnotes at end of table.

TABLE 11.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
67B---------- Pemene	4S	Slight	Slight	Moderate	Slight	Northern red oak----	65	59	Red pine, white spruce, Norway spruce.
						Red maple----------	---	---	
						Sugar maple---------	60	38	
						Paper birch---------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						Eastern white pine--	---	---	
						Red pine-----------	---	---	
						Balsam fir----------	---	---	
67D---------- Pemene	4R	Moderate	Moderate	Moderate	Slight	Northern red oak----	65	59	Red pine, white spruce, Norway spruce.
						Red maple----------	---	---	
						Sugar maple---------	60	38	
						Paper birch---------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						Eastern white pine--	---	---	
						Red pine-----------	---	---	
						Balsam fir----------	---	---	
68B**:									
Cunard---------	3A	Slight	Moderate	Slight	Moderate	Sugar maple---------	60	38	Red pine, white spruce.
						American basswood---	---	---	
						American beech------	---	---	
						White ash----------	---	---	
						Northern red oak----	---	---	
						Bigtooth aspen------	---	---	
Sundell--------	2W	Slight	Severe	Slight	Moderate	Red maple----------	55	38	White spruce, Norway spruce.
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Northern white-cedar	---	---	
						Balsam poplar-------	---	---	
69B**:									
Onaway---------	3A	Slight	Slight	Slight	Slight	Sugar maple---------	65	40	White spruce, Norway spruce, red pine.
						Quaking aspen-------	---	---	
						Balsam fir----------	---	---	
						American beech------	---	---	
						Paper birch---------	---	---	
						American basswood---	65	59	
						White ash----------	---	---	
Rousseau-------	5S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	65	73	Red pine, jack pine.
						Red maple----------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Eastern hemlock-----	---	---	
						Red pine-----------	---	---	
						Paper birch---------	65	73	
						Bigtooth aspen------	---	---	
Solona---------	3W	Slight	Severe	Slight	Moderate	Sugar maple---------	64	40	Eastern white pine, white spruce, Norway spruce.
						Red maple----------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Quaking aspen-------	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked, even-aged, unmanaged stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
10B---------- ONaway	Slight---------	Moderate: slope.	Slight---------	Year round.	Slight---------	Moderate: slope.	Slight.
10D---------- Onaway	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
11B---------- Posen	Moderate: stones.	Moderate: slope, stones.	Moderate: stones.	Year round.	Moderate: stones.	Moderate: slope, stones.	Moderate: stones.
12B---------- Nadeau	Slight---------	Moderate: slope.	Slight---------	Year round.	Slight---------	Moderate: slope.	Slight.
12D---------- Nadeau	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
14*: Minocqua---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.
Tawas----------	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter---	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
15A---------- Gladwin	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
16---------- Ensley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.
17*: Cathro----------	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter---	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Ensley----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
18*:							
Lupton	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Cathro	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
19*:							
Loxley	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Dawson	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
20A Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
21 Deford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
22A Wainola	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
23B Rousseau	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
23D Rousseau	Moderate: slope, too sandy.	Severe: slope.	Moderate: slope, too sandy.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
24*:							
Arnheim	Severe: wetness.	Severe: wetness.	Severe: wetness, flooding.	Winter	Slight	Slight	Slight.
Moquah	Slight	Slight	Slight	Year round.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
25B*:							
Onaway	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Rousseau	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
26B Rubicon	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
28A Ingalls	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
29 Burleigh	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
30B*:							
Cunard	Slight	Slight	Moderate: depth to rock.	Year round.	Slight	Slight	Moderate: depth to rock.
Onaway	Slight	Slight	Slight	Year round.	Slight	Slight	Slight.
32A*:							
Sundell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Moderate: depth to rock.
Ensign	Severe: wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Summer, winter.	Slight	Slight	Severe: depth to rock.
33*:							
Nahma	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Moderate: depth to rock.
Ruse	Severe: wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Summer, winter.	Slight	Slight	Severe: depth to rock.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
35*:							
Lupton	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Tawas	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
36*:							
Chippeny	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Nahma	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Moderate: depth to rock.
37B*:							
Mancelona	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Nadeau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
38A Rousseau	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
44*:							
Tawas	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Deford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
45C*:							
Deford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
Wainola	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
45C*:							
Rousseau	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
46 Pickford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
49C*:							
Cathro	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
Onaway	Slight	Severe: slope.	Slight	Year round.	Slight	Severe: slope.	Slight.
50B Grayling	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
51B*:							
Pemene	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Rubicon	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
52B*:							
Onaway	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Nadeau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
52D*:							
Onaway	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
Nadeau	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
53B*:							
Pemene	Moderate: rock outcrop.	Moderate: rock outcrop.	Moderate: rock outcrop.	Year round.	Moderate: rock outcrop.	Moderate: rock outcrop.	Moderate: rock outcrop.
Rousseau	Moderate: rock outcrop, too sandy.	Moderate: rock outcrop, too sandy.	Moderate: rock outcrop, too sandy.	Spring, fall, winter.	Moderate: rock outcrop.	Moderate: rock outcrop.	Moderate: rock outcrop.
Rock outcrop.							
54C*:							
Tawas	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Banat	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
Nadeau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
55B*:							
Nadeau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Summerville	Slight	Moderate: slope.	Moderate: depth to rock.	Year round.	Slight	Moderate: slope.	Moderate: depth to rock.
56A Amasa	Slight	Slight	Slight	Year round.	Slight	Slight	Slight.
58A Banat	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
59B*:							
Nahma	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Moderate: depth to rock.
Sundell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Moderate: depth to rock.
Summerville	Slight	Slight	Moderate: depth to rock.	Year round.	Slight	Slight	Moderate: depth to rock.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
60B*:							
Onaway	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
61B*:							
Pemene	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
Nadeau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
62B*:							
Summerville	Slight	Slight	Moderate: depth to rock.	Year round.	Slight	Slight	Moderate: depth to rock.
Cunard	Slight	Slight	Moderate: depth to rock.	Year round.	Slight	Slight	Moderate: depth to rock.
63B*:							
Bowers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Ingalls	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
64A*:							
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
Ingalls	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
66B*:							
Johnswood	Moderate: stones.	Moderate: stones.	Moderate: stones.	Year round.	Moderate: stones.	Moderate: stones.	Moderate: stones.
Detour	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 12.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Landings	Logging roads		Logging areas and skid trails	Landings	Logging roads
67B---------- Pemene	Slight---------	Moderate: slope.	Slight---------	Year round.	Slight---------	Moderate: slope.	Slight.
67D---------- Pemene	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
68B*: Cunard----------	Slight---------	Slight---------	Moderate: depth to rock.	Year round.	Slight---------	Slight--------	Moderate: depth to rock.
Sundell----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Moderate: depth to rock.
69B*: Onaway----------	Slight---------	Moderate: slope.	Slight---------	Year round.	Slight---------	Moderate: slope.	Slight.
Rousseau---------	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Moderate: slope.	Slight.
Solona----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight---------	Slight--------	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
10B, 10D---------- Onaway	---	Nannyberry viburnum, silky dogwood, lilac, American cranberrybush.	White spruce, Amur maple, northern white-cedar.	Red pine, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
11B. Posen					
12B, 12D---------- Nadeau	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
14*: Minocqua.					
Tawas.					
15A---------- Gladwin	---	Lilac, American cranberrybush, nannyberry viburnum, Roselow sargent crabapple, Amur maple, silky dogwood.	White spruce, northern white-cedar, Manchurian crabapple.	Eastern white pine, green ash.	Carolina poplar.
16---------- Ensley	---	American cranberrybush, Roselow sargent crabapple, silky dogwood, Amur privet, nannyberry viburnum, common ninebark.	White spruce, northern white-cedar.	Eastern white pine, green ash, red maple.	---
17*: Cathro.					
Ensley---------- Ensley	---	American cranberrybush, Roselow sargent crabapple, silky dogwood, Amur privet, nannyberry viburnum, common ninebark.	White spruce, northern white-cedar.	Eastern white pine, green ash, red maple.	---
18*: Lupton.					
Cathro.					

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
19*: Loxley. Dawson.					
20A---------- Solona	---	Common ninebark, lilac, silky dogwood, northern white-cedar, American cranberrybush, redosier dogwood, nannyberry viburnum.	White spruce------	Eastern white pine, white ash, silver maple, red maple.	---
21---------- Deford	---	Nannyberry viburnum, lilac, silky dogwood, American cranberrybush, common ninebark.	Northern white-cedar, Amur maple.	Eastern white pine, Norway spruce, white spruce, green ash.	Imperial Carolina poplar.
22A---------- Wainola	---	White spruce, silky dogwood, Tatarian honeysuckle, American cranberrybush, Amur privet.	Northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, golden willow, Austrian pine.	Imperial Carolina poplar.
23B, 23D---------- Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
24*: Arnheim.					
Moquah----------	---	Northern white-cedar, lilac, redosier dogwood, silky dogwood, American cranberrybush, nannyberry viburnum.	White spruce------	Eastern white pine, red pine, white ash, red maple, silver maple.	---
25B*: Onaway----------	---	Nannyberry viburnum, silky dogwood, lilac, American cranberrybush.	White spruce, Amur maple, northern white-cedar.	Red pine, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
Rousseau---------	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
26B---------- Rubicon	Manyflower cotoneaster.	Eastern redcedar, Siberian crabapple, Amur privet, lilac, silky dogwood, Amur maple, Siberian peashrub.	---	Red pine, eastern white pine, jack pine.	---
27A*: Urban land.					
Rousseau---------	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
28A---------- Ingalls	---	American cranberrybush, silky dogwood, Amur privet, common ninebark, Roselow sargent crabapple.	White spruce, northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
29. Burleigh					
30B*: Cunard----------	---	White spruce------	Red pine----------	Arrowwood---------	Imperial Carolina poplar.
Onaway----------	---	Nannyberry viburnum, silky dogwood, lilac, American cranberrybush.	White spruce, Amur maple, northern white-cedar.	Red pine, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
32A*: Sundell----------	---	Silky dogwood, Amur privet, lilac, Siberian peashrub.	White spruce, northern white-cedar, Manchurian crabapple.	Eastern white pine, Norway spruce, jack pine, red pine.	Imperial Carolina poplar.
Ensign.					
33*: Nahma.					
Ruse.					
34*: Urban land.					
Deford----------	---	Nannyberry viburnum, lilac, silky dogwood, American cranberrybush, common ninebark.	Northern white-cedar, Amur maple.	Eastern white pine, Norway spruce, white spruce, green ash.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
35*: Lupton.					
Tawas.					
36*: Chippeny.					
Nahma.					
37B*: Mancelona--------	---	Amur maple, lilac, eastern redcedar, Siberian peashrub, nannyberry viburnum.	White spruce, Siberian crabapple, northern white-cedar.	Red pine, jack pine, eastern white pine, Norway spruce.	---
Nadeau----------	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
38A---------- Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
40. Lupton					
41. Aquents					
42*. Pits					
44*: Tawas.					
Deford----------	---	Nannyberry viburnum, lilac, silky dogwood, American cranberrybush, common ninebark.	Northern white-cedar, Amur maple.	Eastern white pine, Norway spruce, white spruce, green ash.	Imperial Carolina poplar.
45C*: Deford----------	---	Nannyberry viburnum, lilac, silky dogwood, American cranberrybush, common ninebark.	Northern white-cedar, Amur maple.	Eastern white pine, Norway spruce, white spruce, green ash.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
45C*:					
Wainola	---	White spruce, silky dogwood, Tatarian honeysuckle, American cranberrybush, Amur privet.	Northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, golden willow, Austrian pine.	Imperial Carolina poplar.
Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
46 Pickford	---	Silky dogwood, American cranberrybush, silky dogwood, common ninebark, nannyberry viburnum.	White spruce, Manchurian crabapple, red maple, northern white-cedar.	Eastern white pine, green ash.	---
49C*:					
Cathro.					
Solona	---	Common ninebark, lilac, silky dogwood, northern white-cedar, American cranberrybush, redosier dogwood, nannyberry viburnum.	White spruce	Eastern white pine, white ash, silver maple, red maple.	---
Onaway	---	Nannyberry viburnum, silky dogwood, lilac, American cranberrybush.	White spruce, Amur maple, northern white-cedar.	Red pine, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
50B Grayling	Vanhoutte spirea, manyflower cotoneaster.	Lilac, Siberian peashrub, Amur privet, eastern redcedar, Amur maple.	Jack pine	Eastern white pine, red pine.	---
51B*:					
Pemene	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
Rubicon	Manyflower cotoneaster.	Eastern redcedar, Siberian crabapple, Amur privet, lilac, silky dogwood, Amur maple, Siberian peashrub.	---	Red pine, eastern white pine, jack pine.	---

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
52B*, 52D*: Onaway	---	American cranberrybush, silky dogwood, Siberian crabapple, arrowwood, nannyberry viburnum, Amur privet, lilac.	White spruce	Red pine, eastern white pine, Norway spruce.	Imperial Carolina poplar.
Nadeau	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
53B*: Pemene	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
Rock outcrop.					
54C*: Tawas.					
Banat	---	Amur maple, common ninebark, lilac, Siberian peashrub, Roselow sargent crabapple.	Siberian crabapple, white spruce.	Norway spruce, eastern white pine, red pine, jack pine, green ash.	---
Nadeau	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
55B*: Nadeau	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
Summerville.					
56A Amasa	---	Lilac, Amur maple, silky dogwood.	Siberian crabapple, white spruce.	Norway spruce, red pine, jack pine, eastern white pine.	---

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
58A---------- Banat	---	Amur maple, common ninebark, lilac, Siberian peashrub, Roselow sargent crabapple.	Siberian crabapple, white spruce.	Norway spruce, eastern white pine, red pine, jack pine, green ash.	---
59B*: Nahma.					
Sundell----------	---	Silky dogwood, Amur privet, lilac, Siberian peashrub.	White spruce, northern white-cedar, Manchurian crabapple.	Eastern white pine, Norway spruce, jack pine, red pine.	Imperial Carolina poplar.
Summerville.					
60B*: Onaway----------	---	Nannyberry viburnum, silky dogwood, lilac, American cranberrybush.	White spruce, Amur maple, northern white-cedar.	Red pine, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
Solona----------	---	Common ninebark, lilac, silky dogwood, northern white-cedar, American cranberrybush, redosier dogwood, nannyberry viburnum.	White spruce------	Eastern white pine, white ash, silver maple, red maple.	---
61B* Pemene----------	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
Nadeau----------	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
62B*: Summerville.					
Cunard----------	---	White spruce------	Red pine----------	Arrowwood---------	Imperial Carolina poplar.
63B*: Bowers----------	---	Silky dogwood, American cranberrybush, Amur privet, common ninebark.	White spruce, northern white-cedar, Siberian crabapple.	Eastern white pine, Norway spruce, green ash, jack pine.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
63B*:					
Ingalls	---	American cranberrybush, silky dogwood, Amur privet, common ninebark, Roselow sargent crabapple.	White spruce, northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
64A*:					
Solona	---	Common ninebark, lilac, silky dogwood, northern white-cedar, American cranberrybush, redosier dogwood, nannyberry viburnum.	White spruce	Eastern white pine, white ash, silver maple, red maple.	---
Ingalls	---	American cranberrybush, silky dogwood, Amur privet, common ninebark, Roselow sargent crabapple.	White spruce, northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
66B*:					
Johnswood.					
Detour.					
67B, 67D Pemene	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern white-cedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
68B*:					
Cunard.					
Sundell	---	Silky dogwood, Amur privet, lilac, Siberian peashrub.	White spruce, northern white-cedar, Manchurian crabapple.	Eastern white pine, Norway spruce, jack pine, red pine.	Imperial Carolina poplar.
69B*:					
Onaway	---	Nannyberry viburnum, silky dogwood, lilac, American cranberrybush.	White spruce, Amur maple, northern white-cedar.	Red pine, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 13.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
69B*: Solona----------	---	Common ninebark, lilac, silky dogwood, northern white-cedar, American cranberrybush, redosier dogwood, nannyberry viburnum.	White spruce------	Eastern white pine, white ash, silver maple, red maple.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
10B Onaway	Slight	Slight	Severe: slope.	Slight.
10D Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
11B Posen	Moderate: large stones.	Moderate: large stones.	Severe: slope, small stones.	Moderate: large stones.
12B Nadeau	Slight	Slight	Severe: slope.	Slight.
12D Nadeau	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14*: Minocqua	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
15A Gladwin	Severe: wetness.	Severe: wetness.	Severe: small stones, wetness.	Severe: wetness.
16 Ensley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
17*: Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Ensley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
18*: Lupton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
19*: Loxley	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.
Dawson	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
20A Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
21 Deford	Severe: ponding.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.
22A Wainola	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
23B Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
23D Rousseau	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
24*: Arnheim	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Moquah	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight.
25B*: Onaway	Slight	Slight	Severe: slope.	Slight.
Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
26B Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
27A*: Urban land.				
Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
28A Ingalls	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
29 Burleigh	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.
30B*: Cunard	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
Onaway	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
32A*:				
Sundell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ensign	Severe: wetness, thin layer, area reclaim.	Severe: wetness, thin layer, area reclaim.	Severe: wetness, thin layer, area reclaim.	Severe: wetness.
33*:				
Nahma	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Ruse	Severe: ponding, thin layer.	Severe: ponding, thin layer.	Severe: ponding, thin layer.	Severe: ponding.
34*:				
Urban land.				
Deford	Severe: ponding.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.
35*:				
Lupton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
36*:				
Chippeny	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Nahma	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
37B*:				
Mancelona	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
Nadeau	Slight	Slight	Moderate: slope, small stones.	Slight.
38A Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
40 Lupton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
41. Aquents				

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
42*. Pits				
44*: Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Deford	Severe: ponding.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.
45C*: Deford	Severe: ponding.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.
Wainola	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
46 Pickford	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
49C*: Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Onaway	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
50B Grayling	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
51B*: Pemene	Slight	Slight	Severe: slope.	Slight.
Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
52B*: Onaway	Slight	Slight	Severe: slope.	Slight.
Nadeau	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
52D*:				
Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Nadeau	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
53B*:				
Pemene	Slight	Slight	Severe: slope.	Slight.
Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Rock outcrop.				
54C*:				
Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Banat	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Nadeau	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
55B*:				
Nadeau	Slight	Slight	Severe: slope.	Slight.
Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Slight.
56A Amasa	Slight	Slight	Slight	Slight.
58A Banat	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
59B*:				
Nahma	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Sundell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Slight.
60B*:				
Onaway	Slight	Slight	Severe: slope.	Slight.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
61B*:				
Pemene	Slight	Slight	Severe: slope.	Slight.
Nadeau	Slight	Slight	Severe: slope.	Slight.
62B*:				
Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Slight.
Cunard	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
63B*:				
Bowers	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Ingalls	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
64A*:				
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ingalls	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
66B*:				
Johnswood	Severe: wetness.	Moderate: wetness, large stones.	Severe: large stones, small stones.	Severe: large stones.
Detour	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
67B Pemene	Slight	Slight	Severe: slope.	Slight.
67D Pemene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
68B*:				
Cunard	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
Sundell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
69B*:				
Onaway	Slight	Slight	Severe: slope.	Slight.
Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
10B---------- Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10D---------- Onaway	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
11B---------- Posen	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
12B---------- Nadeau	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
12D---------- Nadeau	Very poor.	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
14*:										
Minocqua----------	Fair	Good	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Tawas----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
15A---------- Gladwin	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Fair	Fair	Very poor.
16---------- Ensley	Good	Good	Poor	Poor	Poor	Good	Good	Good	Poor	Good.
17*:										
Cathro----------	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
Ensley----------	Good	Good	Poor	Poor	Poor	Good	Good	Good	Poor	Good.
18*:										
Lupton----------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Cathro----------	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
19*:										
Loxley----------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Dawson----------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
20A---------- Solona	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
21---------- Deford	Poor	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
22A---------- Wainola	Fair	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
23B---------- Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 15.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
23D---------- Rousseau	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24*:										
Arnheim----------	Poor	Fair	Poor	Poor	Poor	Good	Fair	Poor	Poor	Fair.
Moquah----------	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
25B*:										
Onaway----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rousseau----------	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
26B---------- Rubicon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
27A*: Urban land.										
Rousseau----------	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Poor.
28A---------- Ingalls	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
29---------- Burleigh	Very poor.	Very poor.	Fair	Fair	Fair	Good	Good	Very poor.	Fair	Good.
30B*:										
Cunard----------	Fair	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.
Onaway----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
32A*:										
Sundell----------	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ensign----------	Poor	Poor	Fair	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
33*:										
Nahma----------	Very poor.	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair.
Ruse----------	Poor	Fair	Fair	Poor	Poor	Good	Poor	Fair	Poor	Fair.
34*: Urban land.										
Deford----------	Poor	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
35*:										
Lupton----------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Tawas----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

See footnote at end of table.

TABLE 15.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
36*: Chippeny	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Nahma	Very poor.	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair.
37B*: Mancelona	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Nadeau	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
38A---- Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Poor.
40---- Lupton	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
41. Aquents										
42*. Pits										
44*: Tawas	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Deford	Poor	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
45C*: Deford	Poor	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
Wainola	Fair	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
46---- Pickford	Poor	Good	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
49C*: Cathro	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
Solona	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
50B---- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
51B*: Pemene	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Rubicon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.

See footnote at end of table.

TABLE 15.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
52B*:										
Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Nadeau	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
52D*:										
Onaway	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Nadeau	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
53B*:										
Pemene	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Rock outcrop.										
54C*:										
Tawas	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Banat	Fair	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
Nadeau	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
55B*:										
Nadeau	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
Summerville	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
56A Amasa	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
58A Banat	Fair	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
59B*:										
Nahma	Very poor.	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair.
Sundell	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Summerville	Very poor.	Poor	Poor	Poor	Poor	Poor	Very poor.	Poor	Poor	Very poor.
60B*:										
Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Solona	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

See footnote at end of table.

TABLE 15.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
61B*:										
Pemene	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Nadeau	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
62B*:										
Summerville	Very poor.	Poor	Poor	Poor	Poor	Poor	Very poor.	Poor	Poor	Very poor.
Cunard	Fair	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Fair	Very poor.
63B*:										
Bowers	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
Ingalls	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
64A*:										
Solona	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ingalls	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
66B*:										
Johnswood	Poor	Fair	Fair	Fair	Poor	Poor	Very poor.	Poor	Fair	Very poor.
Detour	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
67B---- Pemene	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
67D---- Pemene	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
68B*:										
Cunard	Fair	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Sundell	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
69B*:										
Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Solona	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
10B---------- Onaway	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
10D---------- Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
11B---------- Posen	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
12B---------- Nadeau	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: droughty.
12D---------- Nadeau	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14*:						
Minocqua---------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
Tawas----------	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
15A---------- Gladwin	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
16---------- Ensley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
17*:						
Cathro----------	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Ensley----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
18*:						
Lupton----------	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Cathro----------	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
19*:						
Loxley	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
Dawson	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
20A--- Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Severe: wetness.
21--- Deford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
22A--- Wainola	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
23B--- Rousseau	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Moderate: droughty.
23D--- Rousseau	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
24*:						
Arnheim	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
Moquah	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
25B*:						
Onaway	Slight---	Slight---	Slight---	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
Rousseau	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Moderate: droughty.
26B--- Rubicon	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Severe: droughty.
27A*:						
Urban land.						
Rousseau	Severe: cutbanks cave.	Slight---	Moderate: wetness.	Slight---	Slight---	Moderate: droughty.
28A--- Ingalls	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
29--- Burleigh	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
30B*:						
Cunard	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, large stones.
Onaway	Slight	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones.
32A*:						
Sundell	Severe: depth to rock, wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Ensign	Severe: depth to rock, wetness.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: depth to rock, wetness, frost action.	Severe: wetness, thin layer, area reclaim.
33*:						
Nahma	Severe: depth to rock, ponding.	Severe: ponding.	Severe: ponding, depth to rock.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Ruse	Severe: depth to rock, ponding.	Severe: ponding, depth to rock.	Severe: ponding, depth to rock.	Severe: ponding, depth to rock.	Severe: depth to rock, ponding, frost action.	Severe: ponding, thin layer.
34*:						
Urban land.						
Deford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
35*:						
Lupton	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Tawas	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
36*:						
Chippeny	Severe: ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Nahma	Severe: depth to rock, ponding.	Severe: ponding.	Severe: ponding, depth to rock.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
37B*:						
Mancelona	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones, droughty.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
37B*: Nadeau	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: droughty.
38A---- Rousseau	Severe: cutbanks cave.	Slight----	Moderate: wetness.	Slight----	Slight----	Moderate: droughty.
40---- Lupton	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
41. Aquents						
42*. Pits						
44*: Tawas	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Deford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
45C*: Deford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Wainola	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Rousseau	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight----	Moderate: droughty.
46---- Pickford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
49C*: Cathro	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Severe: wetness.
Onaway	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
50B---- Grayling	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight----	Severe: droughty.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
51B*:						
Pemene	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
Rubicon	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
52B*:						
Onaway	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
Nadeau	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: droughty.
52D*:						
Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Nadeau	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
53B*:						
Pemene	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
Rousseau	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Rock outcrop.						
54C*:						
Tawas	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Banat	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Nadeau	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Moderate: droughty, slope.
55B*:						
Nadeau	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: droughty.
Summerville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
56A Amasa	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Slight.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
58A---------- Banat	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
59B*:						
Nahma----------	Severe: depth to rock, ponding.	Severe: ponding.	Severe: ponding, depth to rock.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Sundell----------	Severe: depth to rock, wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Summerville------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
60B*:						
Onaway----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
Solona----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Severe: wetness.
61B*:						
Pemene----------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
Nadeau----------	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: droughty.
62B*:						
Summerville------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
Cunard----------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, large stones.
63B*:						
Bowers----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Ingalls----------	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
64A*:						
Solona----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Severe: wetness.
Ingalls----------	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
66B*:						
Johnswood--------	Severe: large stones, wetness.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: large stones.	Severe: large stones, droughty.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
66B*: Detour	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
67B---- Pemene	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
67D---- Pemene	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
68B*: Cunard	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, large stones.
Sundell	Severe: depth to rock, wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
69B*: Onaway	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
Rousseau	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Severe: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "poor," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
10B Onaway	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: large stones.
10D Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
11B Posen	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.	Slight	Poor: large stones.
12B Nadeau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
12D Nadeau	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
14*: Minocqua	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
15A Gladwin	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
16 Ensley	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.
17*: Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Ensley	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
18*:					
Lupton	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
19*:					
Loxley	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
Dawson	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
20A Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
21 Deford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, ponding.
22A Wainola	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
23B Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
23D Rousseau	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
24*:					
Arnheim	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy, wetness.
Moquah	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy.
25B*:					
Onaway	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: large stones.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
25B*:					
Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
26B----------	Severe:	Severe:	Severe:	Severe:	Poor:
Rubicon	poor filter.	seepage, slope.	seepage, too sandy.	seepage.	seepage, too sandy.
27A*:					
Urban land.					
Rousseau	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
28A----------	Severe:	Severe:	Severe:	Severe:	Poor:
Ingalls	wetness, percs slowly, poor filter.	seepage, wetness.	wetness.	seepage, wetness.	wetness.
29----------	Severe:	Severe:	Severe:	Severe:	Poor:
Burleigh	ponding, percs slowly, poor filter.	seepage, ponding.	ponding, too sandy.	seepage, ponding.	ponding.
30B*:					
Cunard	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Moderate: seepage.	Poor: area reclaim, small stones.
Onaway	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: large stones.
32A*:					
Sundell	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: depth to rock, wetness.
Ensign	Severe: thin layer, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: seepage, wetness.	Poor: area reclaim, wetness, thin layer.
33*:					
Nahma	Severe: thin layer, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: ponding.	Poor: area reclaim, ponding, thin layer.
Ruse	Severe: thin layer, seepage, ponding.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage, ponding.	Severe: seepage, ponding.	Poor: area reclaim, ponding, thin layer.
34*:					
Urban land.					

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
34*: Deford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, ponding.
35*: Lupton	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
36*: Chippeny	Severe: thin layer, seepage, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: ponding.	Poor: area reclaim, ponding, excess humus.
Nahma	Severe: thin layer, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: ponding.	Poor: area reclaim, ponding, thin layer.
37B*: Mancelona	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Nadeau	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
38A Rousseau	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
40 Lupton	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
41. Aquents					
42*. Pits					
44*: Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
44*:					
Deford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, ponding.
45C*:					
Deford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, ponding.
Wainola	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
46 Pickford	Severe: ponding, percs slowly.	Slight	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
49C*:					
Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Onaway	Moderate: percs slowly, slope.	Moderate: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: large stones, slope.
50B Grayling	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
51B*:					
Pemene	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
52B*:					
Onaway	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: small stones.
Nadeau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
52D*:					
Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Nadeau	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
53B*:					
Pemene	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Rock outcrop.					
54C*:					
Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Banat	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Nadeau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
55B*:					
Nadeau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Summerville	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, large stones.
56A Amasa	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
58A Banat	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
59B*:					
Nahma	Severe: thin layer, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: ponding.	Poor: area reclaim, ponding, thin layer.
Sundell	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: depth to rock, wetness.
Summerville	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, large stones.
60B*:					
Onaway	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: large stones.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
61B*:					
Pemene	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Nadeau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
62B*:					
Summerville	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, large stones.
Cunard	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Moderate: seepage.	Poor: area reclaim, small stones.
63B*:					
Bowers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ingalls	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
64A*:					
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ingalls	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
66B*:					
Johnswood	Severe: wetness, percs slowly, large stones.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: wetness.	Poor: large stones, wetness.
Detour	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: small stones, wetness.
67B---------- Pemene	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
67D---------- Pemene	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, slope.
68B*:					
Cunard	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Moderate: seepage.	Poor: area reclaim, small stones.
Sundell	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: depth to rock, wetness.
69B*:					
Onaway	Moderate: percs slowly.	Severe: seepage, slope.	Slight	Slight	Fair: large stones.
Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
10B Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
10D Onaway	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, slope.
11B Posen	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim.
12B Nadeau	Fair: large stones.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
12D Nadeau	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
14*: Minocqua	Poor: wetness.	Probable	Probable	Poor: small stones, area reclaim.
Tawas	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
15A Gladwin	Poor: wetness.	Probable	Probable	Poor: small stones, area reclaim.
16 Ensley	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
17*: Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Ensley	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
18*: Lupton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
18*: Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
19*: Loxley	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
Dawson	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
20A Solona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
21 Deford	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
22A Wainola	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
23B Rousseau	Good	Probable	Improbable: too sandy.	Poor: too sandy.
23D Rousseau	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
24*: Arnheim	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Moquah	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
25B*: Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Rousseau	Good	Probable	Improbable: too sandy.	Poor: too sandy.
26B Rubicon	Good	Probable	Improbable: too sandy.	Poor: too sandy.
27A*: Urban land.				
Rousseau	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
28A Ingalls	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
29--- Burleigh	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
30B*:				
Cunard---	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Onaway---	Good---	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
32A*:				
Sundell---	Poor: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ensign---	Poor: area reclaim, wetness, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness, thin layer.
33*:				
Nahma---	Poor: area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, large stones, wetness.
Ruse---	Poor: area reclaim, wetness, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness.
34*:				
Urban land.				
Deford---	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
35*:				
Lupton---	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Tawas---	Poor: wetness.	Probable---	Improbable: too sandy.	Poor: excess humus, wetness.
36*:				
Chippeny---	Poor: area reclaim, wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Nahma---	Poor: area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, large stones, wetness.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
37B*:				
Mancelona	Good	Probable	Probable	Poor: small stones, area reclaim.
Nadeau	Fair: large stones.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
38A Rousseau	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
40 Lupton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
41. Aquents				
42*. Pits				
44*:				
Tawas	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
Deford	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
45C*:				
Deford	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
Wainola	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
Rousseau	Good	Probable	Improbable: too sandy.	Poor: too sandy.
46 Pickford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
49C*:				
Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Solona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
50B---------- Grayling	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
51B*: Pemene----------	Good----------	Probable----------	Improbable: too sandy.	Poor: small stones.
Rubicon----------	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
52B*: Onaway----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim.
Nadeau----------	Fair: large stones.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
52D*: Onaway----------	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope, area reclaim.
Nadeau----------	Fair: large stones, slope.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
53B*: Pemene----------	Good----------	Probable----------	Improbable: too sandy.	Poor: small stones.
Rousseau----------	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
Rock outcrop.				
54C*: Tawas----------	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: excess humus, wetness.
Banat----------	Poor: wetness.	Probable----------	Probable----------	Poor: small stones, area reclaim, wetness.
Nadeau----------	Fair: large stones.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
55B*: Nadeau----------	Fair: large stones.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
55B*:				
Summerville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, thin layer.
56A	Fair:	Probable	Improbable:	Fair:
Amasa	wetness.		too sandy.	small stones, thin layer.
58A	Poor:	Probable	Probable	Poor:
Banat	wetness.			small stones, area reclaim, wetness.
59B*:				
Nahma	Poor: area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, large stones, wetness.
Sundell	Poor: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Summerville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, thin layer.
60B*:				
Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Solona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
61B*:				
Pemene	Good	Probable	Improbable: too sandy.	Poor: small stones.
Nadeau	Fair: large stones.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
62B*:				
Summerville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, thin layer.
Cunard	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
63B*:				
Bowers	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
63B*:				
Ingalls	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
64A*:				
Solona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
Ingalls	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
66B*:				
Johnswood	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
Detour	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.
67B Pemene	Good	Probable	Improbable: too sandy.	Poor: small stones.
67D Pemene	Poor: slope.	Probable	Improbable: too sandy.	Poor: small stones, slope.
68B*:				
Cunard	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Sundell	Poor: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
69B*:				
Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Rousseau	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Solona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
10B---------- Onaway	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
10D---------- Onaway	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones, slope.
11B---------- Posen	Moderate: seepage, slope.	Severe: seepage, piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
12B---------- Nadeau	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
12D---------- Nadeau	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, slope, droughty.
14*:						
Minocqua----------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, droughty.	Wetness, erodes easily, droughty.
Tawas----------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
15A---------- Gladwin	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
16---------- Ensley	Severe: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
17*:						
Cathro----------	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Ensley----------	Severe: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
18*:						
Lupton----------	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
18*: Cathro	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
19*: Loxley	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, too acid.	Wetness.
Dawson	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding	Wetness.
20A Solona	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness.
21 Deford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
22A Wainola	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
23B Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
23D Rousseau	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
24*: Arnheim	Moderate: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, droughty.	Wetness, erodes easily, droughty.
Moquah	Moderate: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Flooding	Favorable.
25B*: Onaway	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
26B Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
27A*: Urban land.						

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
27A*:						
Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Droughty.
28A Ingalls	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, erodes easily, droughty.
29 Burleigh	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, erodes easily, droughty.
30B*:						
Cunard	Moderate: seepage, depth to rock, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Droughty, depth to rock.
Onaway	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
32A*:						
Sundell	Moderate: seepage, depth to rock.	Severe: piping, wetness.	Severe: depth to rock.	Depth to rock, frost action.	Wetness, soil blowing.	Wetness, depth to rock.
Ensign	Severe: depth to rock, seepage.	Severe: piping, wetness.	Severe: depth to rock.	Thin layer, frost action.	Wetness	Wetness, depth to rock, area reclaim.
33*:						
Nahma	Moderate: seepage, depth to rock.	Severe: piping, ponding.	Severe: depth to rock.	Ponding, thin layer, large stones.	Large stones, ponding, soil blowing.	Large stones, wetness, depth to rock.
Ruse	Severe: depth to rock, seepage.	Severe: piping, ponding, thin layer.	Severe: depth to rock.	Ponding, thin layer, frost action.	Ponding, thin layer.	Wetness, depth to rock, area reclaim.
34*:						
Urban land.						
Deford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
35*:						
Lupton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Tawas	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
36*: Chippeny	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, thin layer, subsides.	Ponding, soil blowing, thin layer.	Wetness, area reclaim.
Nahma	Moderate: seepage, depth to rock.	Severe: piping, ponding.	Severe: depth to rock.	Ponding, thin layer, large stones.	Large stones, ponding, soil blowing.	Large stones, wetness, depth to rock.
37B*: Mancelona	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Nadeau	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
38A Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Droughty.
40 Lupton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding	Wetness.
41. Aquents						
42*. Pits						
44*: Tawas	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Deford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
45C*: Deford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
Wainola	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
46 Pickford	Slight	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding	Wetness, erodes easily.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
49C*:						
Cathro	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Solona	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness.
Onaway	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones, slope.
50B Grayling	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
51B*:						
Pemene	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
52B*:						
Onaway	Moderate: slope, seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
Nadeau	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
52D*:						
Onaway	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones, slope.
Nadeau	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, slope, droughty.
53B*:						
Pemene	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Rock outcrop.						
54C*:						
Tawas	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Banat	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, erodes easily, droughty.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
54C*:						
Nadeau	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, slope, droughty.
55B*:						
Nadeau	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
Summerville	Severe: depth to rock, seepage.	Severe: piping, large stones, thin layer.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
56A Amasa	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, soil blowing, erodes easily.	Erodes easily.
58A Banat	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, erodes easily, droughty.
59B*:						
Nahma	Moderate: seepage, depth to rock.	Severe: piping, ponding.	Severe: depth to rock.	Ponding, thin layer, large stones.	Large stones, ponding, soil blowing.	Large stones, wetness, depth to rock.
Sundell	Moderate: seepage, depth to rock.	Severe: piping, wetness.	Severe: depth to rock.	Depth to rock, frost action.	Wetness, soil blowing.	Wetness, depth to rock.
Summerville	Severe: depth to rock, seepage.	Severe: piping, large stones, thin layer.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
60B*:						
Onaway	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
Solona	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness.
61B*:						
Pemene	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Nadeau	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
62B*:						
Summerville	Severe: depth to rock, seepage.	Severe: piping, large stones, thin layer.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
62B*:						
Cunard	Moderate: seepage, depth to rock, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Droughty, depth to rock.
63B*:						
Bowers	Moderate: slope.	Severe: wetness.	Severe: slow refill.	Frost action, slope.	Wetness, slope.	Wetness.
Ingalls	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, erodes easily, droughty.
64A*:						
Solona	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness.
Ingalls	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, erodes easily, droughty.
66B*:						
Johnswood	Moderate: slope.	Severe: seepage, piping, large stones.	Severe: no water.	Large stones, slope.	Slope, large stones, wetness.	Large stones, wetness.
Detour	Moderate: slope.	Severe: wetness.	Severe: slow refill.	Large stones, frost action, slope.	Slope, large stones, wetness.	Large stones, wetness, rooting depth.
67B Pemene	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Droughty.
67D Pemene	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, droughty.
68B*:						
Cunard	Moderate: seepage, depth to rock, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Droughty, depth to rock.
Sundell	Moderate: seepage, depth to rock.	Severe: piping, wetness.	Severe: depth to rock.	Depth to rock, frost action.	Wetness, soil blowing.	Wetness, depth to rock.
69B*:						
Onaway	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Solona	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
10B, 10D--------- Onaway	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, SC	A-4, A-6	0-20	85-100	80-100	80-95	40-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	25-80	15-25	4-10
11B-------------- Posen	0-8	Cobbly fine sandy loam.	ML, SM, SC, CL	A-4, A-2, A-1-b	20-50	95-100	65-95	55-80	30-65	<30	NP-10
	8-15	Very gravelly fine sandy loam, very gravelly loam, gravelly loam.	ML, CL, SM, SC	A-2, A-4, A-1-b	30-65	95-100	45-85	35-80	25-65	<30	NP-10
	15-60	Extremely gravelly sandy loam, very gravelly sandy loam.	ML, CL, SM, SC	A-2, A-4, A-1-b	20-30	95-100	30-75	25-75	25-70	<25	NP-7
12B, 12D--------- Nadeau	0-15	Fine sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	85-100	80-100	55-95	25-70	<30	NP-10
	15-19	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-40	40-65	30-55	15-50	10-50	20-30	3-10
	19-60	Very gravelly coarse sand, very gravelly sand.	GW, GW, SW, SW-SM	A-1	5-40	40-75	30-65	10-35	0-10	---	NP
14*: Minocqua-------- Tawas----------	0-7	Mucky silt loam	CL, ML, SC, SM	A-4	0-7	80-100	75-100	60-100	45-90	<30	NP-10
	7-14	Silt loam, loam, fine sandy loam.	SC, SM, CL, ML	A-2, A-4, A-6	0-7	80-100	75-100	45-100	25-90	<35	NP-13
	14-22	Loamy coarse sand, gravelly loamy sand, gravelly sandy loam.	SM, GM, GP, SP	A-2, A-1, A-3, A-4	0-7	50-100	45-100	5-70	2-40	<20	NP-4
	22-60	Gravelly coarse sand, sand, very gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-7	35-100	30-100	5-70	0-30	---	NP
	0-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Fine sand, mucky fine sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	80-100	60-100	50-75	0-20	---	NP
15A-------------- Gladwin	0-3	Loamy sand-------	SM, SP-SM	A-2	0-5	90-100	65-95	55-70	10-30	<20	NP-4
	3-17	Sand, loamy sand	SM, SP-SM	A-1, A-2, A-3	0-5	90-100	65-95	45-70	5-30	<20	NP-4
	17-25	Loamy sand, sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2	0-5	85-100	65-90	55-75	15-35	12-35	NP-16
	25-60	Gravelly sand, sand, loamy sand.	SP, GP, SP-SM, GP-GM	A-1	0-10	40-80	35-70	20-45	0-10	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
16----------	0-6	Mucky silt loam	ML, CL-ML	A-4	0-10	90-100	85-100	75-90	50-65	<25	NP-6
Ensley	6-18	Sandy loam, loam, fine sandy loam.	SC, SM-SC	A-6, A-4, A-2	0-10	85-100	85-100	55-95	25-50	20-30	6-16
	18-60	Sandy loam, fine sandy loam, gravelly fine sandy loam.	SM-SC, SM	A-2, A-4	0-10	70-95	70-95	50-75	20-40	<20	NP-7
17*:											
Cathro----------	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-22	Sapric material, muck.	PT	A-8	0	---	---	---	---	---	---
	22-60	Sandy loam, silt loam, clay loam.	SM, ML, SC, CL	A-4, A-6	0-5	80-100	65-100	60-100	35-90	15-40	3-25
Ensley----------	0-6	Mucky silt loam	ML, CL-ML	A-4	0-10	90-100	85-100	75-90	50-65	<25	NP-6
	6-18	Sandy loam, loam, fine sandy loam.	SC, SM-SC	A-6, A-4, A-2	0-10	85-100	85-100	55-95	25-50	20-30	6-16
	18-60	Sandy loam, fine sandy loam, gravelly fine sandy loam.	SM-SC, SM	A-2, A-4	0-10	70-95	70-95	50-75	20-40	<20	NP-7
18*:											
Lupton----------	0-10	Sapric material	PT	A-8	---	---	---	---	---	---	---
	10-60	Sapric material	PT	A-8	---	---	---	---	---	---	---
Cathro----------	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-22	Sapric material, muck.	PT	A-8	0	---	---	---	---	---	---
	22-60	Sandy loam, silt loam, clay loam.	SM, ML, SC, CL	A-4, A-6	0-5	80-100	65-100	60-100	35-90	15-40	3-25
19*:											
Loxley----------	0-8	Fibric material	PT	A-8	0	---	---	---	---	---	---
	8-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Dawson----------	0-6	Fibric material	PT	A-8	---	---	---	---	---	---	---
	6-22	Sapric material	PT	A-8	---	---	---	---	---	---	---
	22-60	Sand, loamy fine sand, gravelly sand.	SM-SC, SM, SC, SP-SM	A-2, A-3, A-1	0	90-100	50-100	25-90	0-30	<20	NP-10
20A----------	0-7	Loam----------	ML, CL, CL-ML	A-4	0-3	80-100	75-100	65-100	50-90	20-30	3-10
Solona	7-21	Fine sandy loam, sandy loam, loam.	CL, ML, SC, SM	A-2, A-4	0-3	80-100	75-100	45-100	25-80	20-30	3-10
	21-60	Loam, sandy loam, gravelly fine sandy loam.	ML, CL, SM, SC	A-2, A-4, A-1	0-3	75-100	60-100	35-95	20-75	<25	NP-10
21----------	0-7	Mucky fine sand	SM	A-2-4	0	100	95-100	65-80	20-35	---	NP
Deford	7-60	Fine sand, very fine sand, loamy fine sand.	SM	A-2-4	0	100	95-100	50-80	15-35	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
22A---------- Wainola	0-10	Fine sand--------	SM	A-2-4	0	100	90-100	65-80	20-35	---	NP
	10-39	Fine sand, loamy fine sand, very fine sand.	SM	A-2-4	0	100	90-100	50-80	15-35	---	NP
	39-60	Fine sand, loamy fine sand, very fine sand.	SM	A-2-4	0	100	90-100	50-80	15-35	---	NP
23B, 23D---------- Rousseau	0-4	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand--------	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-25	---	NP
	27-60	Fine sand, sand	SP, SP-SM	A-3	0	100	100	85-100	0-10	---	NP
24*:											
Arnheim---------	0-16	Mucky silt loam	ML, CL-ML, SM, SM-SC	A-4	0	100	100	90-100	40-90	<25	NP-6
	16-60	Stratified silt loam to sand.	ML, SM, CL, SC	A-2-4, A-4, A-3	0	100	100	50-100	5-90	<30	NP-10
Moquah----------	0-11	Loam----------	CL, CL-ML, ML	A-4	0	100	100	85-100	60-90	20-30	3-10
	11-60	Stratified silt loam to sand.	ML, SM, SC, CL	A-2, A-4	0	100	100	65-100	15-70	<28	NP-9
25B*:											
Onaway----------	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, SC	A-4, A-6	0-20	85-100	80-100	80-95	40-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	25-80	15-25	4-10
Rousseau--------	0-4	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand--------	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-25	---	NP
	27-60	Fine sand, sand	SP, SP-SM	A-3	0	100	100	85-100	0-10	---	NP
26B---------- Rubicon	0-6	Sand----------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	6-36	Sand----------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	36-60	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-90	0-25	---	NP
27A*: Urban land.											
Rousseau--------	0-4	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand, loamy fine sand.	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-35	---	NP
	27-60	Fine sand, sand	SP, SP-SM, SM	A-3, A-2-4	0	100	100	85-100	0-15	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
28A---------- Ingalls	0-11	Fine sand--------	SM, SP-SM	A-2, A-3	0-8	100	75-100	50-75	5-30	---	NP
	11-25	Loamy sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0-8	100	60-100	60-95	5-30	---	NP
	25-60	Stratified silt to loamy fine sand.	CL, CL-ML	A-6, A-4	0	100	90-100	65-95	65-95	20-35	4-15
29---------- Burleigh	0-8	Mucky fine sand	SP-SM	A-3, A-2-4	0	100	95-100	50-70	5-10	---	NP
	8-30	Sand, fine sand	SP-SM, SM	A-3, A-2-4	0	100	95-100	50-70	5-35	---	NP
	30-60	Stratified very fine sand to silt loam.	ML, SM	A-4	0	100	95-100	75-100	35-90	20-40	NP-10
30B*: Cunard----------	0-4	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-15	90-100	70-100	40-95	20-75	<25	NP-7
	4-17	Loam, fine sandy loam, sandy loam.	ML, SM, CL, SC	A-2-4, A-4, A-1-b	0-15	90-100	70-100	40-95	20-75	<30	NP-10
	17-28	Gravelly loam, gravelly fine sandy loam, gravelly sandy loam.	SM, GM, ML	A-1-b, A-2-4, A-4	0-15	65-95	60-90	30-75	15-60	<30	NP-7
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Onaway----------	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, SC	A-4, A-6	0-20	85-100	80-100	80-95	40-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	25-80	15-25	4-10
32A*: Sundell----------	0-7	Loam----------	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	55-95	25-75	<20	2-9
	7-11	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	65-95	25-75	<20	2-9
	11-23	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	55-95	25-75	15-30	2-10
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ensign----------	0-5	Loam----------	ML	A-4	0-5	90-100	85-100	70-95	55-75	20-35	NP-10
	5-15	Loam, fine sandy loam.	ML, CL, SM, SC	A-2-4, A-4	0-5	90-100	85-100	65-95	30-75	15-35	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
33*: Nahma----------	0-10	Sapric material	PT	A-8	0	---	---	---	---	---	---
	10-23	Gravelly sandy loam, fine sandy loam, loam.	SM, ML, CL-ML, SM-SC	A-4, A-2	4-30	95-100	95-100	55-95	25-75	20-35	2-9
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
33*:											
Ruse	0-6	Mucky loam	SM, ML	A-2-4, A-4	0-15	95-100	90-100	60-95	30-75	<35	5-10
	6-18	Sandy loam, gravelly sandy loam, loam.	SM, ML	A-2-4, A-4	0-15	95-100	90-100	50-95	20-75	<35	5-10
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
34*:											
Urban land.											
Deford	0-7	Mucky fine sand	SM	A-2-4	0	100	95-100	65-80	20-35	---	NP
	7-60	Fine sand, very fine sand, loamy fine sand.	SM	A-2-4	0	100	95-100	50-80	15-35	---	NP
35*:											
Lupton	0-10	Sapric material	PT	A-8	---	---	---	---	---	---	---
	10-60	Sapric material	PT	A-8	---	---	---	---	---	---	---
Tawas	0-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Fine sand, mucky fine sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	80-100	60-100	50-75	0-20	---	NP
36*:											
Chippeny	0-30	Sapric material	PT	---	---	---	---	---	---	---	---
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Nahma	0-10	Sapric material	PT	A-8	0	---	---	---	---	---	---
	10-23	Gravelly sandy loam, gravelly fine sandy loam, loam.	SM, ML, GM	A-4, A-2-4	4-30	95-100	75-100	45-85	20-55	20-30	2-9
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
37B*:											
Mancelona	0-12	Loamy sand	SM, ML	A-2, A-1-b, A-4	0-5	90-100	65-95	40-90	15-55	---	NP
	12-24	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1-b	0-5	90-100	65-95	40-80	10-30	---	NP
	24-32	Gravelly loamy sand, sandy clay loam, sandy loam.	SM, SM-SC, SC	A-2, A-4	0-5	85-100	60-95	50-70	15-45	12-30	NP-10
	32-60	Very gravelly sand, gravelly sand, sand.	GP, SP, GW, SW	A-1	5-10	40-90	35-85	20-40	0-10	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
37B*:											
Nadeau----------	0-15	Fine sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	85-100	80-100	55-95	25-70	<30	NP-10
	15-19	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-40	40-65	30-55	15-50	10-50	20-30	3-10
	19-60	Very gravelly coarse sand, very gravelly sand.	GW, GW, SW, SW-SM	A-1	5-40	40-75	30-65	10-35	0-10	---	NP
38A---------- Rousseau	0-4	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand, loamy fine sand.	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-35	---	NP
	27-60	Fine sand, sand	SP, SP-SM, SM	A-3, A-2-4	0	100	100	85-100	0-15	---	NP
40---------- Lupton	0-10	Sapric material	PT	A-8	0	---	---	---	---	---	---
	10-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
41. Aquents											
42*. Pits											
44*:											
Tawas----------	0-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	80-100	60-100	50-75	0-20	---	NP
Deford----------	0-7	Mucky fine sand	SM	A-2-4	0	100	95-100	65-80	20-35	---	NP
	7-60	Fine sand, very fine sand, loamy fine sand.	SM	A-2-4	0	100	95-100	50-80	15-35	---	NP
45C*:											
Deford----------	0-7	Mucky fine sand	SM	A-2-4	0	100	95-100	65-80	20-35	---	NP
	7-60	Fine sand, very fine sand, loamy fine sand.	SM	A-2-4	0	100	95-100	50-80	15-35	---	NP
Wainola----------	0-10	Fine sand--------	SM	A-2-4	0	100	90-100	65-80	20-35	---	NP
	10-39	Fine sand, loamy fine sand, very fine sand.	SM	A-2-4	0	100	90-100	50-80	15-35	---	NP
	39-60	Fine sand, loamy fine sand, very fine sand.	SM	A-2-4	0	100	90-100	50-80	15-35	---	NP
Rousseau---------	0-4	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand--------	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-25	---	NP
	27-60	Fine sand, sand	SP, SP-SM	A-3	0	100	100	85-100	0-10	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
46---------- Pickford	0-7	Mucky silty clay loam.	CL	A-7	0	100	100	90-100	75-95	40-50	20-30
	7-24	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	42-70	21-42
	24-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	42-70	29-45
49C*:											
Cathro----------	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-22	Sapric material, muck.	PT	A-8	0	---	---	---	---	---	---
	22-60	Sandy loam, silt loam, clay loam.	SM, ML, SC, CL	A-4, A-6	0-5	80-100	65-100	60-100	35-90	15-40	3-25
Solona----------	0-7	Loam----------	ML, CL, CL-ML	A-4	0-3	80-100	75-100	65-100	50-90	20-30	3-10
	7-21	Fine sandy loam, sandy loam, loam.	CL, ML, SC, SM	A-2, A-4	0-3	80-100	75-100	45-100	25-80	20-30	3-10
	21-60	Loam, sandy loam, gravelly fine sandy loam.	ML, CL, SM, SC	A-2, A-4, A-1	0-3	75-100	60-100	35-95	20-75	<25	NP-10
Onaway----------	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, SC	A-4, A-6	0-20	85-100	80-100	80-95	40-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	25-80	15-25	4-10
50B---------- Grayling	0-4	Sand----------	SM, SP-SM	A-1, A-2, A-3	0	100	90-100	35-65	5-15	---	NP
	4-60	Sand, coarse sand	SP, SP-SM	A-1, A-3, A-2	0	100	90-100	40-55	0-10	---	NP
51B*:											
Pemene----------	0-21	Loamy fine sand	SM-SC, SM, ML, SP-SM	A-2-4, A-4, A-1-b	0-15	95-100	85-100	40-90	10-55	<25	NP-7
	21-30	Sandy loam, fine sandy loam.	SC, SM, ML, CL	A-2-4, A-4	0-15	95-100	85-100	60-85	25-55	<30	NP-10
	30-60	Loamy sand, sandy loam, gravelly loamy sand.	SM-SC, SM, SP-SM	A-2-4, A-4, A-1-b	0-15	85-100	75-90	30-70	10-40	<25	NP-7
Rubicon----------	0-6	Sand----------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	6-36	Sand----------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	36-60	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-90	0-25	---	NP
52B*, 52D*:											
Onaway----------	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-20	85-100	80-100	80-95	65-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	25-80	15-25	4-10

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
52B*, 52D*:											
Nadeau----------	0-15	Fine sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	85-100	80-100	55-95	25-70	<30	NP-10
	15-19	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-40	40-65	30-55	15-50	10-50	20-30	3-10
	19-60	Very gravelly coarse sand, very gravelly sand.	GW, GW, SW, SW-SM	A-1	5-40	40-75	30-65	10-35	0-10	---	NP
53B*:											
Pemene----------	0-21	Loamy fine sand	SM-SC, SM, ML, SP-SM	A-2-4, A-4, A-1-b	0-15	95-100	85-100	40-90	10-55	<25	NP-7
	21-30	Sandy loam, fine sandy loam.	SC, SM, ML, CL	A-2-4, A-4	0-15	95-100	85-100	60-85	25-55	<30	NP-10
	30-60	Loamy sand, sandy loam, gravelly loamy sand.	SM-SC, SM, SP-SM	A-2-4, A-4, A-1-b	0-15	85-100	75-90	30-70	10-40	<25	NP-7
Rousseau--------	0-4	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand--------	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-25	---	NP
	27-60	Fine sand, sand	SP, SP-SM	A-3	0	100	100	85-100	0-10	---	NP
Rock outcrop.											
54C*:											
Tawas----------	0-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	80-100	60-100	50-75	0-20	---	NP
Banat----------	0-9	Silt loam--------	CL, CL-ML, SM-SC, SC	A-4, A-6	0-10	95-100	75-100	65-95	45-90	15-35	4-14
	9-16	Very gravelly fine sandy loam, very gravelly sandy loam, loam.	GM, GW-GM, SM, SP-SM	A-1, A-2-4, A-4	0-15	40-65	20-55	15-50	10-40	---	NP
	16-60	Extremely gravelly coarse sand, extremely gravelly loamy coarse sand.	GW, GW-GM, SP, SP-SM	A-1	0-15	40-75	20-55	10-35	0-10	---	NP
Nadeau----------	0-15	Fine sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	85-100	80-100	55-95	25-70	<30	NP-10
	15-19	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-40	40-65	30-55	15-50	10-50	20-30	3-10
	19-60	Very gravelly coarse sand, very gravelly sand.	GW, GW, SW, SW-SM	A-1	5-40	40-75	30-65	10-35	0-10	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
55B*:											
Nadeau----------	0-15	Fine sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	85-100	80-100	55-95	25-70	<30	NP-10
	15-19	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-40	40-65	30-55	15-50	10-50	20-30	3-10
	19-60	Very gravelly coarse sand, very gravelly sand.	GW, GW, SW, SW-SM	A-1	5-40	40-75	30-65	10-35	0-10	---	NP
Summerville-----	0-2	Fine sandy loam	SM, SC, CL, ML	A-2-4, A-4	0-10	95-100	95-100	55-85	25-55	<30	NP-10
	2-16	Fine sandy loam, angular cobbly fine sandy loam, angular cobbly sandy loam.	SM, SC, CL, ML	A-2-4, A-4	0-50	95-100	95-100	55-90	25-55	<30	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
56A---------- Amasa	0-3	Very fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	95-100	90-100	65-100	35-90	<25	NP-7
	3-18	Silt loam, very fine sandy loam, fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	95-100	90-100	65-100	35-90	<25	NP-7
	18-60	Sand, loamy sand	SM, SP-SM	A-1, A-3, A-2-4	0	95-100	75-100	45-70	5-20	---	NP
58A---------- Banat	0-9	Silt loam--------	CL, CL-ML, SM-SC, SC	A-4, A-6	0-10	95-100	75-100	65-95	45-90	15-35	4-14
	9-16	Very gravelly fine sandy loam, very gravelly sandy loam, very gravelly loam.	GM, GW-GM, SM, SP-SM	A-1, A-2-4, A-4	0-15	40-65	20-55	15-50	10-40	---	NP
	16-60	Extremely gravelly coarse sand, extremely gravelly loamy coarse sand.	GW, GW-GM, SP, SP-SM	A-1	0-15	40-75	20-55	10-35	0-10	---	NP
59B*:											
Nahma----------	0-10	Sapric material	PT	A-8	0	---	---	---	---	---	---
	10-23	Gravelly sandy loam, gravelly fine sandy loam, loam.	SM, ML, SM-SC	A-4, A-2-4	4-30	95-100	75-100	45-85	20-55	20-30	2-9
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sundell---------	0-7	Loam----------	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	55-95	25-75	<20	2-9
	7-11	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	65-95	25-75	<20	2-9
	11-23	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	55-95	25-75	15-30	2-10
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
59B*:											
Summerville-----	0-2	Fine sandy loam	SM, SC, CL, ML	A-2-4, A-4	0-10	95-100	95-100	55-85	25-55	<30	NP-10
	2-16	Fine sandy loam, angular cobbly fine sandy loam, angular cobbly sandy loam.	SM, SC, CL, ML	A-2-4, A-4	0-50	95-100	95-100	55-90	25-55	<30	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
60B*:											
Onaway----------	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, SC	A-4, A-6	0-20	85-100	80-100	80-95	40-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	28-80	15-25	4-10
Solona----------	0-7	Loam----------	ML, CL, CL-ML	A-4	0-3	80-100	75-100	65-100	50-90	20-30	3-10
	7-21	Fine sandy loam, sandy loam, loam.	CL, ML, SC, SM	A-2, A-4	0-3	80-100	75-100	45-100	25-80	20-30	3-10
	21-60	Loam, sandy loam, gravelly fine sandy loam.	ML, CL, SM, SC	A-2, A-4, A-1	0-3	75-100	60-100	35-95	20-75	<25	NP-10
61B*:											
Pemene----------	0-21	Loamy fine sand	SM-SC, SM, ML, SP-SM	A-2-4, A-4, A-1-b	0-15	95-100	85-100	40-90	10-55	<25	NP-7
	21-30	Sandy loam, fine sandy loam.	SC, SM, ML, CL	A-2-4, A-4	0-15	95-100	85-100	60-85	25-55	<30	NP-10
	30-60	Loamy sand, sandy loam, gravelly loamy sand.	SM-SC, SM, SP-SM	A-2-4, A-4, A-1-b	0-15	85-100	75-90	30-70	10-40	<25	NP-7
Nadeau----------	0-15	Fine sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	85-100	80-100	55-95	25-70	<30	NP-10
	15-19	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-40	40-65	30-55	15-50	10-50	20-30	3-10
	19-60	Very gravelly coarse sand, very gravelly sand.	GW, GW, SW, SW-SM	A-1	5-40	40-75	30-65	10-35	0-10	---	NP
62B*:											
Summerville-----	0-2	Fine sandy loam	SM, SC, CL, ML	A-2-4, A-4	0-10	95-100	95-100	55-85	25-55	<30	NP-10
	2-16	Fine sandy loam, angular cobbly fine sandy loam, angular cobbly sandy loam.	SM, SC, CL, ML	A-2-4, A-4	0-50	95-100	95-100	55-90	25-55	<30	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
62B*:											
Cunard----------	0-4	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-15	90-100	70-100	40-95	20-75	<25	NP-7
	4-17	Loam, fine sandy loam, sandy loam.	ML, SM, CL, SC	A-2-4, A-4, A-1-b	0-15	90-100	70-100	40-95	20-75	<30	NP-10
	17-28	Gravelly loam, gravelly fine sandy loam, gravelly sandy loam.	SM, GM, ML	A-1-b, A-2-4, A-4	0-15	65-95	60-90	30-75	15-60	<30	NP-7
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
63B*:											
Bowers----------	0-4	Silt loam--------	CL	A-4, A-6	0	100	100	85-100	60-95	30-40	9-18
	4-15	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-55	18-30
	15-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-50	18-30
Ingalls---------	0-11	Fine sand--------	SM, SP-SM	A-2, A-3	0-8	100	75-100	50-75	5-30	---	NP
	11-25	Loamy sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0-8	100	60-100	60-95	5-30	---	NP
	25-60	Stratified silt to loamy fine sand.	CL, CL-ML	A-6, A-4	0	100	90-100	65-95	65-95	20-35	4-15
64A*:											
Solona----------	0-7	Loam-------------	ML, CL, CL-ML	A-4	0-3	80-100	75-100	65-100	50-90	20-30	3-10
	7-21	Fine sandy loam, sandy loam, loam.	CL, ML, SC, SM	A-2, A-4	0-3	80-100	75-100	45-100	25-80	20-30	3-10
	21-60	Loam, sandy loam, gravelly fine sandy loam.	ML, CL, SM, SC	A-2, A-4, A-1	0-3	75-100	60-100	35-95	20-75	<25	NP-10
Ingalls---------	0-11	Fine sand--------	SM, SP-SM	A-2, A-3	0-8	100	75-100	50-75	5-30	---	NP
	11-25	Loamy sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0-8	100	60-100	60-95	5-30	---	NP
	25-60	Stratified silt to loamy fine sand.	CL, CL-ML	A-6, A-4	0	100	90-100	65-95	65-95	20-35	4-15
66B*:											
Johnswood-------	0-5	Cobbly loam------	ML, SM	A-4, A-2, A-1	50-80	80-100	60-90	35-90	15-70	25-40	2-9
	5-16	Very cobbly loam, very cobbly fine sandy loam, gravelly loam.	SM, CL, SC, ML	A-4, A-2, A-6, A-1	50-80	80-100	60-90	35-90	15-70	20-40	2-19
	16-60	Cobbly loam, gravelly loam, gravelly fine sandy loam.	CL, SM, SM-SC, SC	A-4, A-6, A-1, A-2	50-80	80-100	60-90	35-90	15-70	15-30	3-15

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
66B*:											
Detour----------	0-5	Loam----------	SM, SC, ML, CL	A-2, A-4	0-15	95-100	90-100	60-95	25-70	15-38	5-10
	5-19	Cobbly loam, cobbly sandy clay loam, fine sandy loam.	SC, CL	A-2, A-6	15-30	70-90	60-75	45-75	20-60	30-40	10-20
	19-60	Gravelly loam, gravelly sandy loam, gravelly fine sandy loam.	SC, CL	A-2, A-6	10-20	70-90	60-75	35-75	15-60	30-35	10-15
67B, 67D---------- Pemene	0-21	Fine sandy loam	SM-SC, SM	A-2-4, A-4	0-15	95-100	85-100	60-85	20-50	<25	NP-7
	21-30	Sandy loam, fine sandy loam.	SC, SM, ML, CL	A-2-4, A-4	0-15	95-100	85-100	60-85	25-55	<30	NP-10
	30-60	Loamy sand, fine sandy loam, gravelly loamy sand.	SM-SC, SM, SP-SM	A-2-4, A-4, A-1-b	0-15	85-100	75-90	30-70	10-40	<25	NP-7
68B*:											
Cunard----------	0-4	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-15	90-100	70-100	40-95	20-75	<25	NP-7
	4-17	Loam, fine sandy loam, sandy loam.	ML, SM, CL, SC	A-2-4, A-4, A-1-b	0-15	90-100	70-100	40-95	20-75	<30	NP-10
	17-28	Gravelly loam, gravelly fine sandy loam, gravelly sandy loam.	SM, GM, ML	A-1-b, A-2-4, A-4	0-15	65-95	60-90	30-75	15-60	<30	NP-7
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sundell----------	0-7	Loam----------	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	55-95	25-75	<20	2-9
	7-11	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	65-95	25-75	<20	2-9
	11-23	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-2, A-4	0-4	95-100	95-100	55-95	25-75	15-25	2-10
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
69B*:											
Onaway----------	0-18	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	90-100	85-95	55-80	25-50	<20	NP-10
	18-25	Loam, clay loam, silty clay loam.	CL, SC	A-4, A-6	0-20	85-100	80-100	80-95	40-90	25-35	7-15
	25-60	Loam, gravelly fine sandy loam.	CL-ML, SC, CL, SM-SC	A-4	0-20	70-95	65-95	35-95	25-80	15-25	4-10
Rousseau---------	0-4	Fine sand---------	SP-SM, SM	A-2-4, A-3	0	100	100	90-100	5-35	---	NP
	4-27	Fine sand---------	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-25	---	NP
	27-60	Fine sand, sand	SP, SP-SM	A-3	0	100	100	85-100	0-10	---	NP

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
69B*:											
Solona----------	0-7	Loam----------	ML, CL, CL-ML	A-4	0-3	80-100	75-100	65-100	50-90	20-30	3-10
	7-21	Fine sandy loam, sandy loam, loam.	CL, ML, SC, SM	A-2, A-4	0-3	80-100	75-100	45-100	25-80	20-30	3-10
	21-60	Loam, sandy loam, gravelly fine sandy loam.	ML, CL, SM, SC	A-2, A-4, A-1	0-3	75-100	60-100	35-95	20-75	<25	NP-10

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
10B, 10D---------	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low----------	0.24	5	3	1-3
Onaway	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low----------	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low----------	0.32			
11B---------------	0-8	5-20	1.30-1.60	2.0-6.0	0.05-0.18	4.5-7.3	Low----------	0.20	5	8	1-3
Posen	8-15	8-17	1.35-1.65	0.6-2.0	0.10-0.16	4.5-7.3	Low----------	0.20			
	15-60	8-18	1.60-1.70	0.6-2.0	0.09-0.16	7.4-8.4	Low----------	0.20			
12B, 12D---------	0-15	2-15	1.15-1.60	0.6-2.0	0.12-0.20	5.6-7.3	Low----------	0.24	4	3	1-3
Nadeau	15-19	8-18	1.25-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low----------	0.17			
	19-60	0-5	1.45-1.65	>20	0.01-0.04	7.9-8.4	Low----------	0.10			
14*:											
Minocqua--------	0-7	8-12	1.20-1.55	0.6-2.0	0.19-0.24	4.5-7.8	Low----------	0.37	4	5	4-10
	7-14	10-18	1.50-1.60	0.6-2.0	0.11-0.19	4.5-7.8	Low----------	0.37			
	14-22	3-10	1.65-1.75	2.0-6.0	0.06-0.13	4.5-7.8	Low----------	0.10			
	22-60	0-3	1.75-1.85	>6.0	0.02-0.04	4.5-8.4	Low----------	0.10			
Tawas-----------	0-25	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	2	2	40-60
	25-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low----------	----			
15A---------------	0-3	0-12	1.25-1.40	6.0-20	0.08-0.12	5.1-7.8	Low----------	0.17	4	2	2-4
Gladwin	3-17	2-15	1.35-1.45	6.0-20	0.05-0.11	5.1-7.8	Low----------	0.17			
	17-25	5-18	1.35-1.45	2.0-6.0	0.05-0.13	5.1-7.8	Low----------	0.17			
	25-60	0-5	1.25-1.50	>6.0	0.02-0.04	6.1-8.4	Low----------	0.10			
16----------------	0-6	10-18	1.30-1.60	2.0-6.0	0.17-0.22	6.1-7.8	Low----------	0.32	5	5	4-7
Ensley	6-18	10-25	1.30-1.70	0.6-2.0	0.10-0.18	6.6-8.4	Moderate-----	0.20			
	18-60	8-18	1.45-1.70	2.0-6.0	0.08-0.12	7.4-8.4	Low----------	0.20			
17*:											
Cathro----------	0-6	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	----------	----	2	2	60-85
	6-22	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
	22-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	----			
Ensley----------	0-6	10-18	1.30-1.60	2.0-6.0	0.17-0.22	6.1-7.8	Low----------	0.32	5	5	4-7
	6-18	10-25	1.30-1.70	0.6-2.0	0.10-0.18	6.6-8.4	Moderate-----	0.20			
	18-60	8-18	1.45-1.70	2.0-6.0	0.08-0.12	7.4-8.4	Low----------	0.20			
18*:											
Lupton----------	0-10	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	2	2	70-90
	10-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.1-7.8	----------	----			
Cathro----------	0-6	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	----------	----	2	2	60-85
	6-22	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
	22-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	----			
19*:											
Loxley----------	0-8	---	0.30-0.40	>6.0	0.35-0.65	<4.5	----------	----	2	5	70-90
	8-60	---	0.10-0.35	0.2-6.0	0.35-0.45	<4.5	----------	----			
Dawson----------	0-6	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	----------	----	2	7	65-85
	6-22	---	0.19-0.29	0.2-6.0	0.35-0.45	3.6-4.4	----------	----			
	22-60	0-10	1.56-1.74	6.0-20	0.03-0.10	3.6-6.5	Low----------	----			

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
20A	0-7	15-20	1.35-1.55	0.6-2.0	0.16-0.24	6.1-7.8	Low	0.32	5	5	1-3
Solona	7-21	12-18	1.45-1.65	0.6-2.0	0.09-0.19	6.6-7.8	Low	0.32			
	21-60	5-20	1.45-1.70	0.6-2.0	0.08-0.19	7.4-8.4	Low	0.32			
21	0-7	0-10	1.35-1.40	6.0-20	0.07-0.09	5.6-7.8	Low	0.17	5	2	4-12
Deford	7-60	0-12	1.40-1.60	6.0-20	0.05-0.07	5.6-8.4	Low	0.17			
22A	0-10	0-10	1.35-1.50	6.0-20	0.07-0.09	4.5-6.5	Low	0.15	5	1	2-4
Wainola	10-39	2-12	1.35-1.45	6.0-20	0.06-0.11	4.5-6.5	Low	0.15			
	39-60	0-10	1.25-1.50	6.0-20	0.05-0.07	5.1-7.3	Low	0.15			
23B, 23D	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	5.1-6.0	Low	0.15	5	1	1-2
Rousseau	4-27	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low	0.15			
24*:											
Arnheim	0-16	12-18	1.15-1.60	0.6-6.0	0.12-0.45	5.6-6.5	Low	0.24	5	8	2-4
	16-60	5-18	1.50-1.80	0.6-2.0	0.05-0.22	6.6-8.4	Low	0.37			
Moquah	0-11	12-18	1.35-1.55	0.6-2.0	0.20-0.24	4.5-7.8	Low	0.32	5	5	2-3
	11-60	8-18	1.55-1.70	0.2-2.0	0.12-0.22	4.5-7.8	Low	0.24			
25B*:											
Onaway	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	5	3	1-3
	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low	0.32			
Rousseau	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	5.1-6.0	Low	0.15	5	1	1-2
	4-27	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low	0.15			
26B	0-6	0-5	1.35-1.45	6.0-20	0.05-0.09	4.5-6.0	Low	0.15	5	1	.5-1
Rubicon	6-36	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low	0.15			
	36-60	0-5	1.40-1.55	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
27A*:											
Urban land.											
Rousseau	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	4.5-6.0	Low	0.15	5	1	1-2
	4-27	0-10	1.30-1.60	2.0-20	0.06-0.11	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-6.5	Low	0.15			
28A	0-11	0-5	1.25-1.40	6.0-20	0.07-0.10	4.5-7.3	Low	0.17	5	1	.5-3
Ingalls	11-25	3-15	1.35-1.45	6.0-20	0.08-0.10	4.5-7.3	Low	0.17			
	25-60	2-25	1.45-1.80	0.2-0.6	0.09-0.22	5.6-8.4	Low	0.43			
29	0-8	0-5	1.35-1.50	6.0-20	0.08-0.10	6.1-7.8	Low	0.15	5	1	2-3
Burleigh	8-30	2-10	1.40-1.55	6.0-20	0.06-0.09	6.1-7.8	Low	0.43			
	30-60	10-28	1.45-1.80	0.2-0.6	0.05-0.20	7.4-8.4	Low	0.43			
30B*:											
Cunard	0-4	5-15	1.30-1.60	2.0-6.0	0.10-0.20	5.6-7.3	Low	0.24	4	3	1-3
	4-17	5-18	1.35-1.70	0.6-2.0	0.09-0.19	5.6-7.8	Low	0.24			
	17-28	5-18	1.60-1.70	0.6-2.0	0.08-0.18	5.6-8.4	Low	0.24			
	28	---	---	---	---	---	---	---			
Onaway	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	5	3	1-3
	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low	0.32			

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
32A*:											
Sundell	0-7	2-15	1.30-1.50	2.0-6.0	0.12-0.22	6.1-7.8	Low	0.24	4	3	5-10
	7-11	2-15	1.30-1.50	0.6-6.0	0.08-0.15	6.1-7.8	Low	0.24			
	11-23	8-18	1.35-1.70	0.6-2.0	0.11-0.19	6.1-8.4	Low	0.24			
	23	---	---	---	---	---	---	---			
Ensign	0-5	15-20	1.30-1.50	0.6-2.0	0.14-0.17	6.1-7.8	Low	0.32	2	6	---
	5-15	10-25	1.40-1.70	0.6-2.0	0.13-0.17	6.1-8.4	Low	0.32			
	15	---	---	---	---	---	---	---			
33*:											
Nahma	0-10	---	1.30-1.60	0.2-6.0	0.35-0.45	6.1-7.8	---	---	2	2	---
	10-23	12-18	1.40-1.70	0.6-2.0	0.10-0.19	6.6-8.4	Low	0.24			
	23	---	---	---	---	---	---	---			
Ruse	0-6	10-20	1.20-1.60	0.6-6.0	0.12-0.22	6.1-7.8	Low	0.24	2	5	---
	6-18	10-25	1.50-1.70	0.6-6.0	0.10-0.20	6.1-7.8	Low	0.24			
	18	---	---	---	---	---	---	---			
34*:											
Urban land.											
Deford	0-7	0-10	1.35-1.40	6.0-20	0.07-0.09	5.6-7.8	Low	0.17	5	2	4-12
	7-60	0-12	1.40-1.60	6.0-20	0.05-0.07	5.6-8.4	Low	0.17			
35*:											
Lupton	0-10	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	---	---	2	2	70-90
	10-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.1-7.8	---	---			
Tawas	0-25	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	---	---	2	2	40-60
	25-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low	---			
36*:											
Chippeny	0-30	---	0.30-0.55	0.2-2.0	0.35-0.45	5.6-7.8	---	---	2	2	55-75
	30	---	---	---	---	---	---	---			
Nahma	0-10	---	1.30-1.60	0.2-6.0	0.35-0.45	6.1-7.8	---	---	2	2	---
	10-23	12-18	1.40-1.70	0.6-2.0	0.10-0.19	6.6-8.4	Low	0.24			
	23	---	---	---	---	---	---	---			
37B*:											
Mancelona	0-12	0-10	1.15-1.60	2.0-6.0	0.10-0.12	5.6-7.3	Low	0.17	4	2	.5-3
	12-24	0-15	1.25-1.50	6.0-20	0.06-0.12	5.6-7.8	Low	0.17			
	24-32	10-25	1.25-1.60	2.0-6.0	0.06-0.16	6.1-7.8	Low	0.17			
	32-60	0-10	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low	0.10			
Nadeau	0-15	2-15	1.15-1.60	0.6-2.0	0.12-0.20	5.6-7.3	Low	0.24	4	3	1-3
	15-19	8-18	1.25-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low	0.17			
	19-60	0-5	1.45-1.65	>20	0.01-0.04	7.9-8.4	Low	0.10			
38A	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	4.5-6.0	Low	0.15	5	1	1-2
Rousseau	4-27	0-10	1.30-1.60	2.0-20	0.06-0.11	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-6.5	Low	0.15			
40	0-10	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	---	---	---	8	70-90
Lupton	10-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	---	---			
41.											
Aquents											

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
42*. Pits											
44*:											
Tawas	0-25	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	---	---	2	2	40-60
	25-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low	---			
Deford	0-7	0-10	1.35-1.40	6.0-20	0.07-0.09	5.6-7.8	Low	0.17	5	2	4-12
	7-60	0-12	1.40-1.60	6.0-20	0.05-0.07	5.6-8.4	Low	0.17			
45C*:											
Deford	0-7	0-10	1.35-1.40	6.0-20	0.07-0.09	5.6-7.8	Low	0.17	5	2	4-12
	7-60	0-12	1.40-1.60	6.0-20	0.05-0.07	5.6-8.4	Low	0.17			
Wainola	0-10	0-10	1.35-1.50	6.0-20	0.07-0.09	4.5-6.5	Low	0.15	5	1	2-4
	10-39	2-12	1.35-1.45	6.0-20	0.06-0.11	4.5-6.5	Low	0.15			
	39-60	0-10	1.25-1.50	6.0-20	0.05-0.07	5.1-7.3	Low	0.15			
Rousseau	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	3.6-6.0	Low	0.15	5	1	1-2
	4-27	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low	0.15			
46	0-7	27-40	1.10-1.35	0.2-0.6	0.20-0.24	5.1-7.8	Moderate	0.37	3	7	2-5
Pickford	7-24	35-60	1.40-1.65	<0.06	0.09-0.13	5.1-7.8	Moderate	0.37			
	24-60	35-60	1.50-1.75	<0.06	0.08-0.12	7.4-8.4	Moderate	0.37			
49C*:											
Cathro	0-6	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	---	---	2	2	60-85
	6-22	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	---	---			
	22-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low	---			
Solona	0-7	15-20	1.35-1.55	0.6-2.0	0.16-0.24	6.1-7.8	Low	0.32	5	5	1-3
	7-21	12-18	1.45-1.65	0.6-2.0	0.09-0.19	6.6-7.8	Low	0.32			
	21-60	5-20	1.45-1.70	0.6-2.0	0.08-0.19	7.4-8.4	Low	0.32			
Onaway	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	5	3	1-3
	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low	0.32			
50B	0-4	0-10	1.30-1.65	6.0-20	0.05-0.09	3.6-5.5	Low	0.15	5	1	---
Grayling	4-60	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
51B*:											
Pemene	0-21	3-15	1.15-1.60	2.0-6.0	0.08-0.12	5.1-6.5	Low	0.17	5	2	.5-3
	21-30	8-20	1.30-1.60	0.6-6.0	0.10-0.16	5.6-7.3	Low	0.24			
	30-60	3-15	1.20-1.50	2.0-6.0	0.06-0.12	6.6-8.4	Low	0.17			
Rubicon	0-6	0-5	1.35-1.45	6.0-20	0.05-0.09	4.5-6.0	Low	0.15	5	1	.5-1
	6-36	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low	0.15			
	36-60	0-5	1.40-1.55	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
52B*, 52D*:											
Onaway	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	5	3	1-3
	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low	0.32			
Nadeau	0-15	2-15	1.15-1.60	0.6-2.0	0.12-0.20	5.6-7.3	Low	0.24	4	3	1-3
	15-19	8-18	1.25-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low	0.17			
	19-60	0-5	1.45-1.65	>20	0.01-0.04	7.9-8.4	Low	0.10			

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
53B*:											
Pemene	0-21	3-15	1.15-1.60	2.0-6.0	0.08-0.12	5.1-6.5	Low	0.17	5	2	.5-3
	21-30	8-20	1.30-1.60	0.6-6.0	0.10-0.16	5.6-7.3	Low	0.24			
	30-60	3-15	1.20-1.50	2.0-6.0	0.06-0.12	7.4-8.4	Low	0.17			
Rousseau	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	5.1-6.0	Low	0.15	5	1	1-2
	4-27	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low	0.15			
Rock outcrop.											
54C*:											
Tawas	0-25	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	---	---	2	2	40-60
	25-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low	---			
Banat	0-9	7-25	1.20-1.55	0.6-2.0	0.20-0.24	5.6-7.8	Low	0.37	3	5	1-3
	9-16	0-8	1.35-1.60	0.6-2.0	0.04-0.09	6.6-7.8	Low	0.17			
	16-60	0-5	1.50-1.70	>20	0.01-0.04	7.4-8.4	Low	0.10			
Nadeau	0-15	2-15	1.15-1.60	0.6-2.0	0.12-0.20	5.6-7.3	Low	0.24	4	3	1-3
	15-19	8-18	1.25-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low	0.17			
	19-60	0-5	1.45-1.65	>20	0.01-0.04	7.9-8.4	Low	0.10			
55B*:											
Nadeau	0-15	2-15	1.15-1.60	0.6-2.0	0.12-0.20	5.6-7.3	Low	0.24	4	3	1-3
	15-19	8-18	1.25-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low	0.17			
	19-60	0-5	1.45-1.65	>20	0.01-0.04	7.9-8.4	Low	0.10			
Summerville	0-2	10-18	1.30-1.60	2.0-6.0	0.08-0.18	6.1-7.8	Low	0.24	2	3	---
	2-16	10-25	1.35-1.65	0.6-2.0	0.06-0.16	6.1-8.4	Low	0.24			
	16	---	---	---	---	---	---	---			
56A	0-3	3-12	1.20-1.60	0.6-2.0	0.16-0.24	4.5-6.0	Low	0.37	4	3	1-2
Amasa	3-18	3-12	1.20-1.70	0.6-2.0	0.15-0.22	4.5-6.0	Low	0.37			
	18-60	0-10	1.50-1.65	6.0-20	0.02-0.09	5.1-6.5	Low	0.10			
58A	0-9	7-25	1.20-1.55	0.6-2.0	0.20-0.24	5.6-7.8	Low	0.37	3	5	1-3
Banat	9-16	0-8	1.35-1.60	0.6-2.0	0.04-0.09	6.6-7.8	Low	0.17			
	16-60	0-5	1.50-1.70	>20	0.01-0.04	7.4-8.4	Low	0.10			
59B*:											
Nahma	0-10	---	1.30-1.60	0.2-6.0	0.35-0.45	6.1-7.8	---	---	2	2	---
	10-23	12-18	1.40-1.70	0.6-2.0	0.10-0.19	6.6-8.4	Low	0.24			
	23	---	---	---	---	---	---	---			
Sundell	0-7	2-15	1.30-1.50	2.0-6.0	0.12-0.22	6.1-7.8	Low	0.24	4	3	5-10
	7-11	2-15	1.30-1.50	0.6-6.0	0.08-0.15	6.1-7.8	Low	0.24			
	11-23	8-18	1.35-1.70	0.6-2.0	0.11-0.19	6.1-8.4	Low	0.24			
	23	---	---	---	---	---	---	---			
Summerville	0-2	10-18	1.30-1.60	2.0-6.0	0.08-0.18	6.1-7.8	Low	0.24	2	3	---
	2-16	10-25	1.35-1.65	0.6-2.0	0.06-0.16	6.1-8.4	Low	0.24			
	16	---	---	---	---	---	---	---			
60B*:											
Onaway	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	5	3	1-3
	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low	0.32			

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
60B*:											
Solona----------	0-7	15-20	1.35-1.55	0.6-2.0	0.16-0.24	6.1-7.8	Low----------	0.32	5	5	1-3
	7-21	12-18	1.45-1.65	0.6-2.0	0.09-0.19	6.6-7.8	Low----------	0.32			
	21-60	5-20	1.45-1.70	0.6-2.0	0.08-0.19	7.4-8.4	Low----------	0.32			
61B*:											
Pemene----------	0-21	3-15	1.15-1.60	2.0-6.0	0.08-0.12	5.1-6.5	Low----------	0.17	5	2	.5-3
	21-30	8-20	1.30-1.60	0.6-6.0	0.10-0.16	5.6-7.3	Low----------	0.24			
	30-60	3-15	1.20-1.50	2.0-6.0	0.06-0.12	6.6-8.4	Low----------	0.17			
Nadeau----------	0-15	2-15	1.15-1.60	0.6-2.0	0.12-0.20	5.6-7.3	Low----------	0.24	4	3	1-3
	15-19	8-18	1.25-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low----------	0.17			
	19-60	0-5	1.45-1.65	>20	0.01-0.04	7.9-8.4	Low----------	0.10			
62B*:											
Summerville-----	0-2	10-18	1.30-1.60	2.0-6.0	0.08-0.18	6.1-7.8	Low----------	0.24	2	3	---
	2-16	10-25	1.35-1.65	0.6-2.0	0.06-0.16	6.1-8.4	Low----------	0.24			
	16	---	---	---	---	---	----------	----			
Cunard----------	0-4	5-15	1.30-1.60	2.0-6.0	0.10-0.20	5.6-7.3	Low----------	0.24	4	3	1-3
	4-17	5-18	1.35-1.70	0.6-2.0	0.09-0.19	5.6-7.8	Low----------	0.24			
	17-28	5-18	1.60-1.70	0.6-2.0	0.08-0.18	5.6-8.4	Low----------	0.24			
	28	---	---	---	---	---	----------	----			
63B*:											
Bowers----------	0-4	20-26	1.40-1.70	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.32	5	5	1-3
	4-15	35-40	1.45-1.60	0.2-0.6	0.18-0.20	6.1-7.3	Moderate-----	0.32			
	15-60	30-40	1.50-1.65	0.2-0.6	0.18-0.22	7.4-8.4	Moderate-----	0.32			
Ingalls----------	0-11	0-5	1.25-1.40	6.0-20	0.07-0.10	4.5-7.3	Low----------	0.17	5	1	.5-3
	11-25	3-15	1.35-1.45	6.0-20	0.08-0.10	4.5-7.3	Low----------	0.17			
	25-60	2-25	1.45-1.80	0.2-0.6	0.09-0.22	5.6-8.4	Low----------	0.43			
64A*:											
Solona----------	0-7	15-20	1.35-1.55	0.6-2.0	0.16-0.24	6.1-7.8	Low----------	0.32	5	5	1-3
	7-21	12-18	1.45-1.65	0.6-2.0	0.09-0.19	6.6-7.8	Low----------	0.32			
	21-60	5-20	1.45-1.70	0.6-2.0	0.08-0.19	7.4-8.4	Low----------	0.32			
Ingalls----------	0-11	0-5	1.25-1.40	6.0-20	0.07-0.10	4.5-7.3	Low----------	0.17	5	1	.5-3
	11-25	3-15	1.35-1.45	6.0-20	0.08-0.10	4.5-7.3	Low----------	0.17			
	25-60	2-25	1.45-1.80	0.2-0.6	0.09-0.22	5.6-8.4	Low----------	0.43			
66B*:											
Johnswood-------	0-5	8-18	1.10-1.60	2.0-6.0	0.04-0.14	6.1-7.8	Low----------	0.24	3	8	1-3
	5-16	8-30	1.35-1.70	0.6-2.0	0.04-0.12	6.1-7.8	Low----------	0.24			
	16-60	10-25	1.75-2.10	0.2-0.6	0.02-0.06	7.9-8.4	Low----------	0.24			
Detour----------	0-5	10-18	1.50-1.80	2.0-6.0	0.11-0.20	5.6-7.3	Low----------	0.24	3	3	2-3
	5-19	10-18	1.40-1.80	0.6-2.0	0.10-0.14	6.6-7.8	Low----------	0.24			
	19-60	10-18	1.70-1.90	0.2-0.6	0.12-0.14	7.4-8.4	Low----------	0.24			
67B, 67D---------	0-21	3-15	1.15-1.60	2.0-6.0	0.11-0.17	5.1-6.5	Low----------	0.24	5	3	.5-3
Pemene	21-30	8-20	1.30-1.60	0.6-6.0	0.10-0.16	5.6-7.3	Low----------	0.24			
	30-60	3-15	1.20-1.50	2.0-6.0	0.06-0.12	6.6-8.4	Low----------	0.17			
68B*:											
Cunard----------	0-4	5-15	1.30-1.60	2.0-6.0	0.10-0.20	5.6-7.3	Low----------	0.24	4	3	1-3
	4-17	5-18	1.35-1.70	0.6-2.0	0.09-0.19	5.6-7.8	Low----------	0.24			
	17-28	5-18	1.60-1.70	0.6-2.0	0.08-0.18	5.6-8.4	Low----------	0.24			
	28	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
68B*:											
Sundell	0-7	2-15	1.30-1.50	2.0-6.0	0.12-0.22	6.1-7.8	Low	0.24	4	3	5-10
	7-11	2-15	1.30-1.50	0.6-6.0	0.08-0.15	6.1-7.8	Low	0.24			
	11-23	8-18	1.35-1.70	0.6-2.0	0.11-0.19	6.1-8.4	Low	0.24			
	23	---	---	---	---	---	---	---			
69B*:											
Onaway	0-18	10-20	1.30-1.70	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	5	3	1-3
	18-25	18-35	1.40-1.80	0.6-2.0	0.12-0.18	5.1-7.8	Low	0.32			
	25-60	5-25	1.30-1.70	0.6-2.0	0.10-0.20	7.4-8.4	Low	0.32			
Rousseau	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	5.1-6.0	Low	0.15	5	1	1-2
	4-27	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low	0.15			
	27-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low	0.15			
Solona	0-7	15-20	1.35-1.55	0.6-2.0	0.16-0.24	6.1-7.8	Low	0.32	5	5	1-3
	7-21	12-18	1.45-1.65	0.6-2.0	0.09-0.19	6.6-7.8	Low	0.32			
	21-60	5-20	1.45-1.70	0.6-2.0	0.08-0.19	7.4-8.4	Low	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 22.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "occasional," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
10B, 10D---------- Onaway	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
11B---------- Posen	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
12B, 12D---------- Nadeau	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
14*:												
Minocqua----------	B/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	High-----	High-----	High.
Tawas------------	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
15A---------- Gladwin	A	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low------	Low.
16---------- Ensley	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
17*:												
Cathro-----------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
Ensley-----------	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
18*:												
Lupton-----------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-May	>60	---	High-----	High-----	Low.
Cathro-----------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
19*:												
Loxley-----------	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	High-----	High-----	High.
Dawson-----------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	High.

See footnote at end of table.

TABLE 22.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
20A---------- Solona	C	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	High-----	High-----	Low.
21---------- Deford	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	Moderate	Low------	Moderate.
22A---------- Wainola	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low------	Moderate.
23B, 23D---------- Rousseau	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
24*:												
Arnheim----------	D	Occasional	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
Moquah----------	B	Occasional	Brief-----	Sep-Jun	3.0-6.0	Apparent	Nov-May	>60	---	Moderate	Moderate	Moderate.
25B*:												
Onaway----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Rousseau---------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
26B---------- Rubicon	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
27A*: Urban land.												
Rousseau---------	A	None--------	---	---	2.5-6.0	Apparent	Nov-May	>60	---	Low------	Low------	Moderate.
28A---------- Ingalls	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Moderate.
29---------- Burleigh	A/D	None--------	---	---	+1-1.0	Apparent	Oct-May	>60	---	Moderate	High-----	Low.
30B*:												
Cunard----------	B	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	Low------	Low.

See footnote at end of table.

TABLE 22.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
30B*:												
Onaway	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
32A*:												
Sundell	B	None	---	---	0.5-1.5	Apparent	Nov-May	20-40	Hard	High	Moderate	Low.
Ensign	D	None	---	---	0.5-1.0	Apparent	Nov-May	10-20	Hard	High	High	Low.
33*:												
Nahma	B/D	None	---	---	+1-1.0	Apparent	Nov-Jun	20-40	Hard	High	High	Low.
Ruse	D	None	---	---	+1-1.0	Apparent	Nov-May	10-20	Hard	High	High	Low.
34*:												
Urban land.												
Deford	A/D	None	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	Moderate	Low	Moderate.
35*:												
Lupton	A/D	None	---	---	+1-1.0	Apparent	Sep-May	>60	---	High	High	Low.
Tawas	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
36*:												
Chippeny	D	None	---	---	+1-1.0	Apparent	Sep-May	20-51	Soft	High	High	Moderate.
Nahma	B/D	None	---	---	+1-1.0	Apparent	Nov-Jun	20-40	Hard	High	High	Low.
37B*:												
Mancelona	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Nadeau	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
38A----------	A	None	---	---	2.5-6.0	Apparent	Nov-May	>60	---	Low	Low	Moderate.
Rousseau												
40----------	D	None	---	---	+2-0.5	Apparent	Sep-Jun	>60	---	High	High	Low.
Lupton												

See footnote at end of table.

TABLE 22.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
41. Aquents												
42*. Pits												
44*:												
Tawas	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
Deford	A/D	None	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	Moderate	Low	Moderate.
45C*:												
Deford	A/D	None	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	Moderate	Low	Moderate.
Wainola	B	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low	Moderate.
Rousseau	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
46 Pickford	D	None	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	Moderate	High	Low.
49C*:												
Cathro	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High	High	Low.
Solona	C	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	High	High	Low.
Onaway	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
50B Grayling	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
51B*:												
Pemene	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Rubicon	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
52B*, 52D*:												
Onaway	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.

See footnote at end of table.

TABLE 22.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
52B*, 52D*:												
Nadeau	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
53B*:												
Pemene	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Rousseau	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Rock outcrop.												
54C*:												
Tawas	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
Banat	B	None	---	---	0.5-1.5	Apparent	Oct-May	>60	---	High	Low	Low.
Nadeau	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
55B*:												
Nadeau	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Summerville	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	Low	Low.
56A Amasa	C	None	---	---	2.5-6.0	Apparent	Oct-May	>60	---	Moderate	Low	Moderate.
58A Banat	B	None	---	---	0.5-1.5	Apparent	Oct-May	>60	---	High	Low	Low.
59B*:												
Nahma	B/D	None	---	---	+1-1.0	Apparent	Nov-Jun	20-40	Hard	High	High	Low.
Sundell	B	None	---	---	0.5-1.5	Apparent	Nov-May	20-40	Hard	High	Moderate	Low.
Summerville	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	Low	Low.
60B*:												
Onaway	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
Solona	C	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	High	High	Low.

See footnote at end of table.

TABLE 22.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
61B*:												
Pemene	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Nadeau	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
62B*:												
Summerville	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	Low	Low.
Cunard	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Low.
63B*:												
Bowers	C	None	---	---	1.0-2.0	Apparent	Nov-Apr	>60	---	High	High	Low.
Ingalls	B	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Moderate.
64A*:												
Solona	C	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	High	High	Low.
Ingalls	B	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Moderate.
66B*:												
Johnswood	B	None	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	Moderate	Low.
Detour	B	None	---	---	0.5-2.0	Apparent	Nov-May	>60	---	High	High	Low.
67B, 67D Pemene	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
68B*:												
Cunard	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Low.
Sundell	B	None	---	---	0.5-1.5	Apparent	Nov-May	20-40	Hard	High	Moderate	Low.
69B*:												
Onaway	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
Rousseau	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Solona	C	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	High	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 23.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
*Amasa	Coarse-loamy over sandy or sandy-skeletal, mixed, frigid Typic Haplorthods
Aquents	Sandy and loamy, mixed, frigid Haplaquents
Arnheim	Coarse-loamy, mixed, nonacid, frigid Aeric Fluvaquents
Banat	Loamy-skeletal, mixed, frigid Aeric Ochraqualfs
Bowers	Fine, mixed Aquic Eutroboralfs
*Burleigh	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
Cathro	Loamy, mixed, euic Terric Borosaprists
Chippeny	Euic Lithic Borosaprists
Cunard	Coarse-loamy, mixed Typic Eutroboralfs
Dawson	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
Deford	Mixed, frigid Typic Psammaquents
*Detour	Fine-loamy, mixed, frigid Aquic Eutrochrepts
Ensign	Loamy, mixed, nonacid, frigid Lithic Haplaquepts
Ensley	Coarse-loamy, mixed, nonacid, frigid Aeric Haplaquepts
Gladwin	Sandy, mixed, frigid Alfic Haplaquods
Grayling	Mixed, frigid Typic Udipsamments
Ingalls	Sandy over loamy, mixed, frigid Entic Haplaquods
Johnswood	Loamy-skeletal, mixed Udic Argiborolls
Loxley	Dysic Typic Borosaprists
Lupton	Euic Typic Borosaprists
Mancelona	Sandy, mixed, frigid Alfic Haplorthods
*Minocqua	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, frigid Typic Haplaquepts
Moquah	Coarse-loamy, mixed, nonacid, frigid Typic Udifluvents
Nadeau	Coarse-loamy, mixed Typic Eutroboralfs
Nahma	Coarse-loamy, mixed, nonacid, frigid Histic Humaquepts
Onaway	Fine-loamy, mixed Typic Eutroboralfs
Pemene	Coarse-loamy, mixed Glossic Eutroboralfs
Pickford	Fine, mixed, nonacid, frigid Typic Haplaquepts
*Posen	Loamy-skeletal, mixed, frigid Typic Eutrochrepts
Rousseau	Sandy, mixed, frigid Entic Haplorthods
Rubicon	Sandy, mixed, frigid Entic Haplorthods
*Ruse	Loamy, mixed, nonacid, frigid Lithic Haplaquepts
Solona	Coarse-loamy, mixed Aquic Eutroboralfs
Summerville	Loamy, mixed, frigid Lithic Eutrochrepts
Sundell	Coarse-loamy, mixed Aquic Haploborolls
Tawas	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Wainola	Sandy, mixed, frigid Entic Haplaquods

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Soil name and map symbol	Land capability	Prime farmland	Habitat type		Woodland ordination symbol	Michigan soil management group
			Primary	Secondary		
10B Onaway	IIIe	Yes	AVO	TM	3A	3a
10D Onaway	VIe	---	AVO	TM	3R	3a
11B Posen	VIs	---	TM	AVO	3X	Ga
12B Nadeau	IVe	---	TM	AVO	2S	3/5a
12D Nadeau	VIIe	---	TM	---	2R	3/5a
14 Minocqua Tawas	VIw	---	TTM	FMC	 7W 5W	 3/5c M/4c
15A Gladwin	IIIw	---	TMC	---	4W	5b
16 Ensley	Vw	Yes*	FMC	---	3W	3c
17 Cathro Ensley	VIw	---	TTM	FMC	 5W 3W	 M/3c 3c
18 Lupton Cathro	 Vw VIw	---	TTM	TTS	 2W 5W	 Mc M/3c
19 Loxley Dawson	VIIw	---	PCS	---	 2W 2W	 Mc M/4c
20A Solona	IIw	Yes*	TM	TMC	3W	3b
21 Deford	Vw	---	FMC	---	4W	5c
22A Wainola	IIIw	---	TMC	---	6W	5b
23B Rousseau	IIIe	---	AQVac	TMV	5S	5.3a
23D Rousseau	VIe	---	AQVac	TMV	5R	5.3a
24 Arnheim Moquah	Vw	---	FMC	---	 5W 3A	 L-2c L-2a
25B Onaway Rousseau	IIIe	---	AVO	ATD	 3A 5S	 3a 5.3a

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Habitat type		Woodland ordination symbol	Michigan soil management group
			Primary	Secondary		
26B---------- Rubicon	VIs	---	AQVib	TMV	4S	5.3a
27A: Urban land. Rousseau.						
28A---------- Ingalls	IIIw	Yes*	TMC	---	4W	4/2b
29---------- Burleigh	Vw	---	FMC	---	2W	4/2c
30B---------- Cunard---------- Onaway----------	IIIe	---	AVO	TM	 3A 3A	 3/Ra 3a
32A---------- Sundell---------- Ensign----------	Vw	---	TMC	TM	 2W 2W	 3/Rbc Rbc
33---------- Nahma---------- Ruse----------	VIw	---	TTM	FMC	 4W 5W	 3/Rbc Rbc
34: Urban land. Deford.						
35---------- Lupton---------- Tawas----------	 Vw VIw	---	TTM	TTS	 2W 5W	 Mc M/4c
36---------- Chippeny---------- Nahma----------	VIw	---	TTM	FMC	 4W 4W	 M/Rc 3/Rbc
37B---------- Mancelona---------- Nadeau----------	IIIs	---	TM	AQVib	 3S 2S	 4a 3/5a
38A---------- Rousseau	IIIs	---	TMV	TMC	5S	5.3a
40---------- Lupton	VIIIw	---	---	---	---	---
41. Aquents						
42. Pits						
44---------- Tawas---------- Deford----------	VIw	---	TTM	FMC	 5W 4W	 M/4c 5c
45C---------- Deford---------- Wainola---------- Rousseau----------	Vw	---	FMC	TMC	 4W 6W 5S	 5c 5b 5.3a

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Habitat type		Woodland ordination symbol	Michigan soil management group
			Primary	Secondary		
46---	Vw	---	---	---	6W	1.5c
Pickford						
49C---	VIw	---	TTM	TM		
Cathro---					5W	M/3c
Solona---					3W	3b
Onaway---					3A	3a
50B---	VIs	---	AQVac	QAE	4S	5.7a
Grayling						
51B---	IVe	---	AQVib	TMV		
Pemene---					4S	4a
Rubicon---					4S	5.3a
52B---	IIIe	---	AVO	TM		
Onaway---					3A	3a
Nadeau---					2S	3/5a
52D---	VIe	---	AVO	TM		
Onaway---					3R	3a
Nadeau---					2R	3/5a
53B---	VIe	---				
Pemene---			AQVib	TMV	4S	4a
Rousseau---			AQVib	TMV	5S	5.3a
Rock outcrop.						
54C---	VIw	---	TTM	TM		
Tawas---					5W	M/4c
Banat---					2W	3/5b
Nadeau---					2S	3/5a
55B---	IVe	---	TMV	AQVib		
Nadeau---					2S	3/5a
Summerville---					3D	Ra
56A---	IIs	Yes	AQVib	ATD	3A	3/5a
Amasa---						
58A---	IIIw	---	TM	---	2W	3/5b
Banat---						
59B---	Vw	---	TTM	TM		
Nahma---					4W	3/Rc
Sundell---					2W	3/Rb
Summerville---					3D	Ra
60B---	IIIe	Yes	ATD	TM		
Onaway---					3A	3a
Solona---					3W	3b
61B---	IIIe	---	AQVib	TMV		
Pemene---					4S	4a
Nadeau---					2S	3/5a
62B---	VIs	---	AVO	ATD		
Summerville---					3D	Ra
Cunard---					3A	3/Ra

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Habitat type		Woodland ordination symbol	Michigan soil management group
			Primary	Secondary		
63B	IIw	Yes*	AVO	TMC		
Bowers					7W	1.5b
Ingalls					4W	4/2b
64A	IIw	Yes*	TMC	TM		
Solona					3W	3b
Ingalls					4W	4/2b
66B	VIs	---	AVO	TM		
Johnswood					3F	Ga
Detour					7W	3b
67B	IIIe	---	AQVib	TMV	4S	3a
Pemene						
67D	VIIe	---	AQVib	TMV	4R	3a
Pemene						
68B	IIIe	---	TM	ATD		
Cunard					3A	3/Ra
Sundell					2W	3/Rbc
69B	IIIe	---	TM	TMV		
Onaway					3A	3a
Rousseau					5S	5.3a
Solona					3W	3b

* Where drained.

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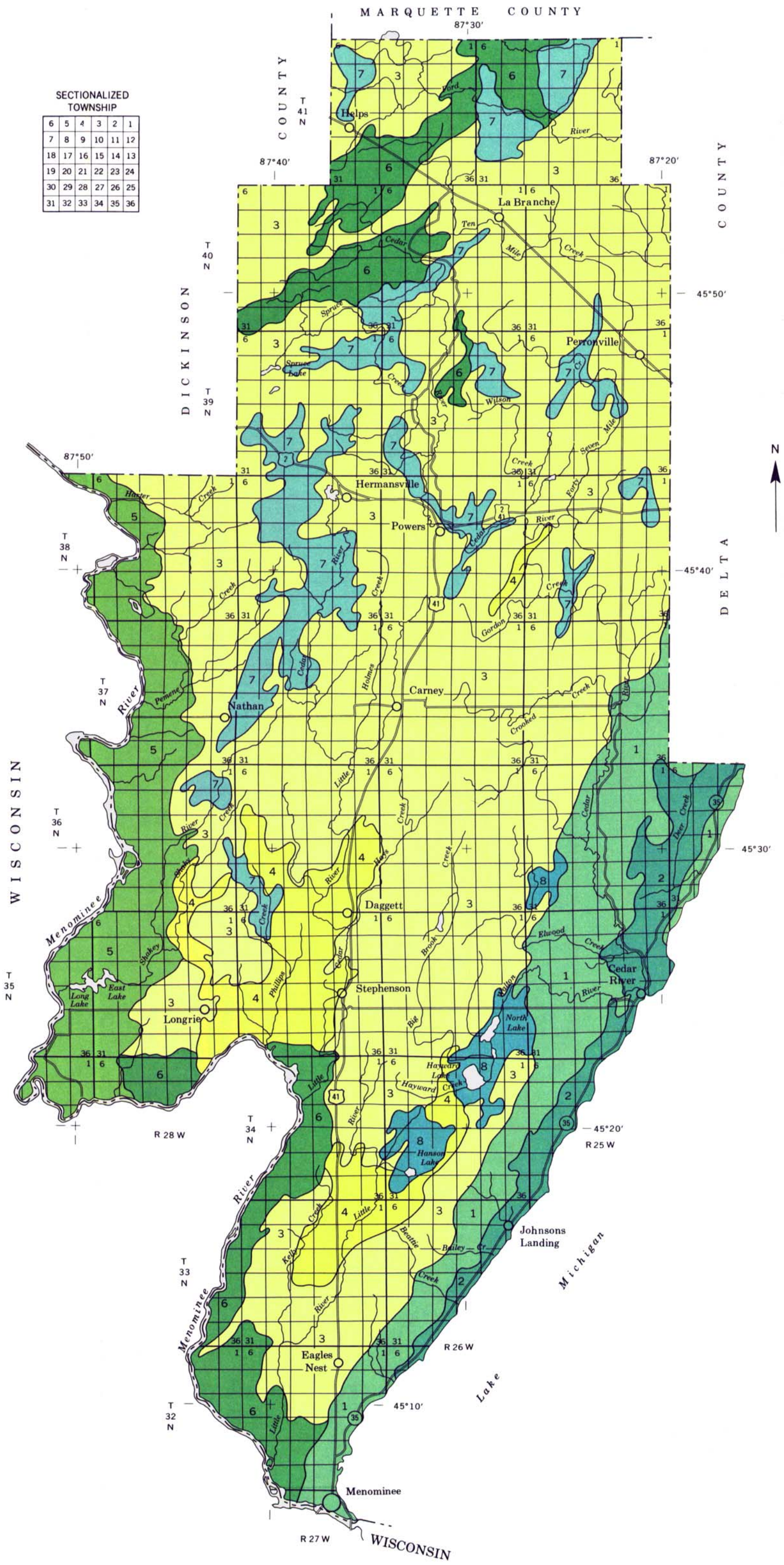
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



LEGEND*

1	DEFORD-WAINOLA-ROUSSEAU: Deep, nearly level to hilly, poorly drained, somewhat poorly drained, and well drained, sandy soils on lake plains and outwash plains
2	SOLONA-PICKFORD-CATHRO: Deep, nearly level, somewhat poorly drained to very poorly drained, loamy, silty, and mucky soils on moraines and lake plains
3	ONAWAY-LUPTON: Deep, nearly level to steep, well drained and very poorly drained, loamy and mucky soils on drumlins and till plains
4	ONAWAY-NADEAU-LUPTON: Deep, nearly level to steep, well drained and very poorly drained, loamy and mucky soils on drumlins and outwash plains
5	PEMENE-GRAYLING-LUPTON: Deep, nearly level to steep, well drained, excessively drained, and very poorly drained, loamy, sandy, and mucky soils on moraines and outwash plains
6	ONAWAY-LUPTON-ROUSSEAU: Deep, nearly level to steep, well drained, moderately well drained, and very poorly drained, loamy, mucky, and sandy soils on drumlins, till plains, and outwash plains
7	ONAWAY-SUMMERVILLE-LUPTON: Deep and shallow, nearly level to steep, well drained and very poorly drained, loamy and mucky soils on drumlins and till plains
8	LUPTON-LOXLEY: Deep, nearly level, very poorly drained, mucky and peaty soils on lake plains

* The texture terms in the descriptive headings refer to the surface layer of the major soils in the map units.

COMPILED 1986

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MICHIGAN DEPARTMENT OF AGRICULTURE
MICHIGAN AGRICULTURAL EXPERIMENT STATION
MICHIGAN TECHNOLOGICAL UNIVERSITY

GENERAL SOIL MAP

MENOMINEE COUNTY, MICHIGAN

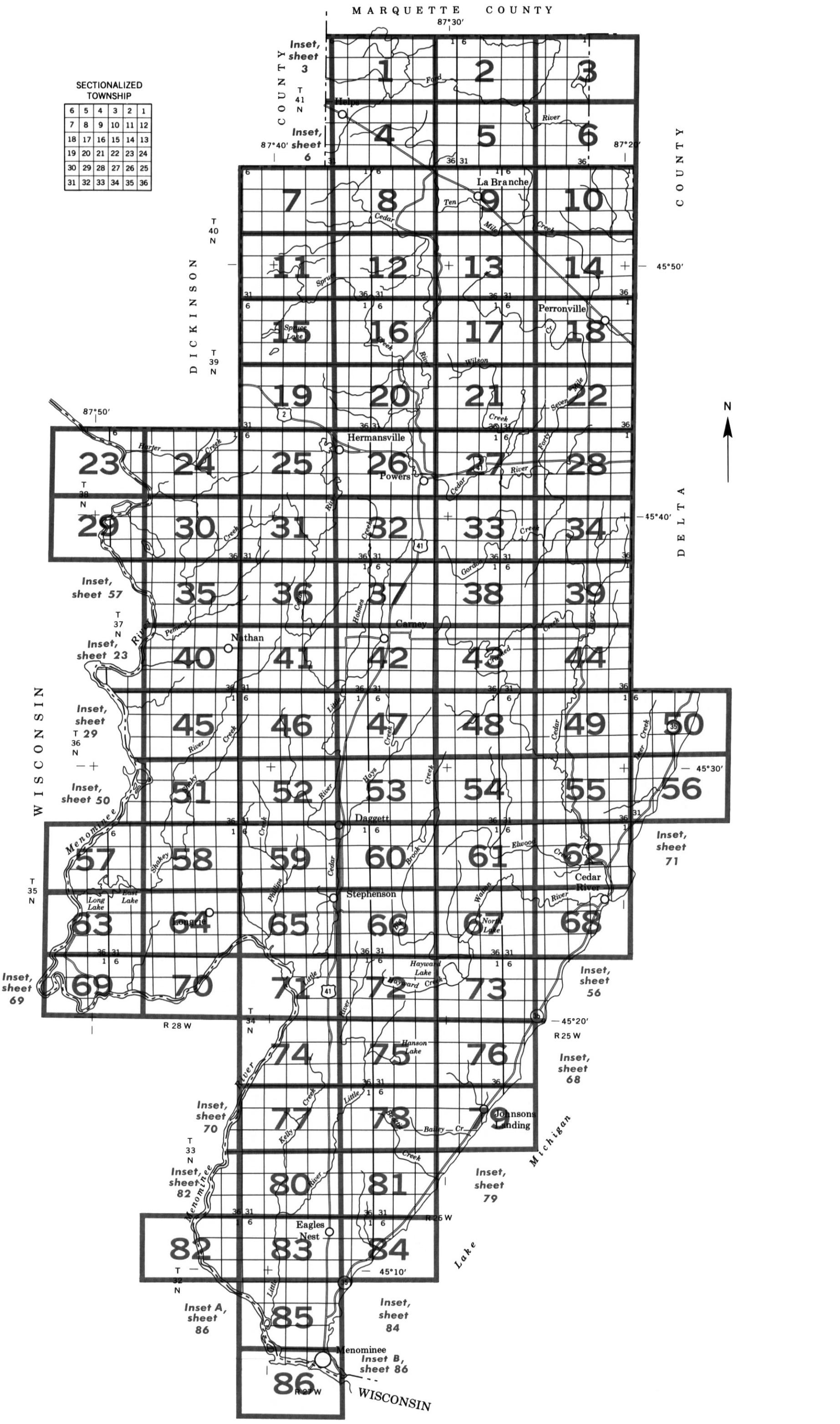
Scale 1:253,440

1 0 1 2 3 4 Mi

1 0 4 8 Km

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS

MENOMINEE COUNTY, MICHIGAN

Scale 1:253,440

1 0 1 2 3 4 Mi

1 0 4 8 Km

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
10B	Onaway fine sandy loam, 3 to 9 percent slopes
10D	Onaway fine sandy loam, 12 to 35 percent slopes
11B	Posen cobbly fine sandy loam, 3 to 12 percent slopes, very stony
12B	Nadeau fine sandy loam, 3 to 12 percent slopes
12D	Nadeau fine sandy loam, 15 to 35 percent slopes
14	Minocqua-Tawas complex
15A	Gladwin loamy sand, 0 to 3 percent slopes
16	Ensley mucky silt loam
17	Cathro-Ensley complex
18	Lupton-Cathro association
19	Loxley-Dawson association
20A	Solona loam, 0 to 3 percent slopes
21	Deford mucky fine sand
22A	Wainola fine sand, 0 to 3 percent slopes
23B	Rousseau fine sand, 3 to 12 percent slopes
23D	Rousseau fine sand, 15 to 25 percent slopes
24	Arnheim-Moquah complex, 0 to 3 percent slopes
25B	Onaway-Rousseau complex, 3 to 12 percent slopes
26B	Rubicon sand, 3 to 12 percent slopes
27A	Urban land-Rousseau complex, 0 to 3 percent slopes
28A	Ingalls fine sand, 0 to 3 percent slopes
29	Burleigh mucky fine sand
30B	Cunard-Onaway fine sandy loams, 0 to 6 percent slopes
32A	Sundell-Ensign loams, 0 to 3 percent slopes
33	Nahma-Ruse complex
34	Urban land-Deford complex
35	Lupton-Tawas association
36	Chippeny-Nahma mucks
37B	Mancelona-Nadeau complex, 0 to 8 percent slopes
38A	Rousseau fine sand, 0 to 3 percent slopes
40	Lupton muck, ponded
41	Aquents, sandy and loamy
42	Pits, sand and gravel
44	Tawas-Deford complex
45C	Deford-Wainola-Rousseau complex, 0 to 12 percent slopes
46	Pickford mucky silty clay loam
49C	Cathro-Solona-Onaway complex, 0 to 15 percent slopes
50B	Grayling sand, 3 to 12 percent slopes
51B	Pemene-Rubicon complex, 3 to 12 percent slopes
52B	Onaway-Nadeau fine sandy loams, 3 to 12 percent slopes
52D	Onaway-Nadeau fine sandy loams, 12 to 35 percent slopes
53B	Pemene-Rousseau-Rock outcrop complex, 3 to 12 percent slopes
54C	Tawas-Banat-Nadeau complex, 0 to 15 percent slopes
55B	Nadeau-Summerville fine sandy loams, 3 to 12 percent slopes
56A	Amasa very fine sandy loam, 0 to 3 percent slopes
58A	Banat silt loam, 0 to 3 percent slopes
59B	Nahma-Sundell-Summerville complex, 0 to 6 percent slopes
60B	Onaway-Solona complex, 0 to 10 percent slopes
61B	Pemene-Nadeau complex, 3 to 12 percent slopes
62B	Summerville-Cunard fine sandy loams, 0 to 6 percent slopes
63B	Bowers-Ingalls complex, 0 to 6 percent slopes
64A	Solona-Ingalls complex, 0 to 2 percent slopes
66B	Johnswood-Detour complex, 2 to 6 percent slopes, very stony
67B	Pemene fine sandy loam, 3 to 12 percent slopes
67D	Pemene fine sandy loam, 15 to 35 percent slopes
68B	Cunard-Sundell complex, 0 to 8 percent slopes
69B	Onaway-Rousseau-Solona complex, 0 to 12 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline
- AD HOC BOUNDARY (label)
- Small airport, airfield, park, oilfield, cemetery, or flood pool (Swift Airport; FLOOD POOL LINE)
- STATE COORDINATE TICK
- LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate (21)
- Federal (173)
- State (28)
- County, farm or ranch (1263)

- RAILROAD
- POWER TRANSMISSION LINE (normally not shown)
- PIPE LINE (normally not shown)
- FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (Gas)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

- SOIL DELINEATIONS AND SYMBOLS (67B / 17)
- ESCARPMENTS
  - Bedrock (points down slope)
  - Other than bedrock (points down slope)
- SHORT STEEP SLOPE
- GULLY
- DEPRESSION OR SINK
- SOIL SAMPLE (normally not shown) (S)
- MISCELLANEOUS
  - Blowout
  - Clay spot
  - Gravelly spot
  - Gumbo, slick or scabby spot (sodic)
  - Dumps and other similar non soil areas
  - Prominent hill or peak
  - Rock outcrop (includes sandstone and shale)
  - Saline spot
  - Sandy spot
  - Severely eroded spot
  - Slide or slip (tips point upslope)
  - Stony spot, very stony spot (0)
  - Area of mineral soil within an area of organic soils (up to 5 acres)
  - Borrow area (up to 5 acres)
  - Area with bedrock less than 40 inches deep (up to 5 acres)
  - Sanitary landfill (up to 5 acres)
  - Loamy spot (up to 5 acres)

MENOMINEE COUNTY, MICHIGAN NO. 1

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

R. 26 W.

MARQUETTE COUNTY

7 850 000 FEET

4 435 000 FEET

T. 41 N.

ESCANABA RIVER

SPALDING

STATE FOREST

Skidmore Creek

Ford River

West Branch

(Joins inset, sheet 3)

(Joins sheet 2)

(Joins sheet 4)

1 865 000 FEET

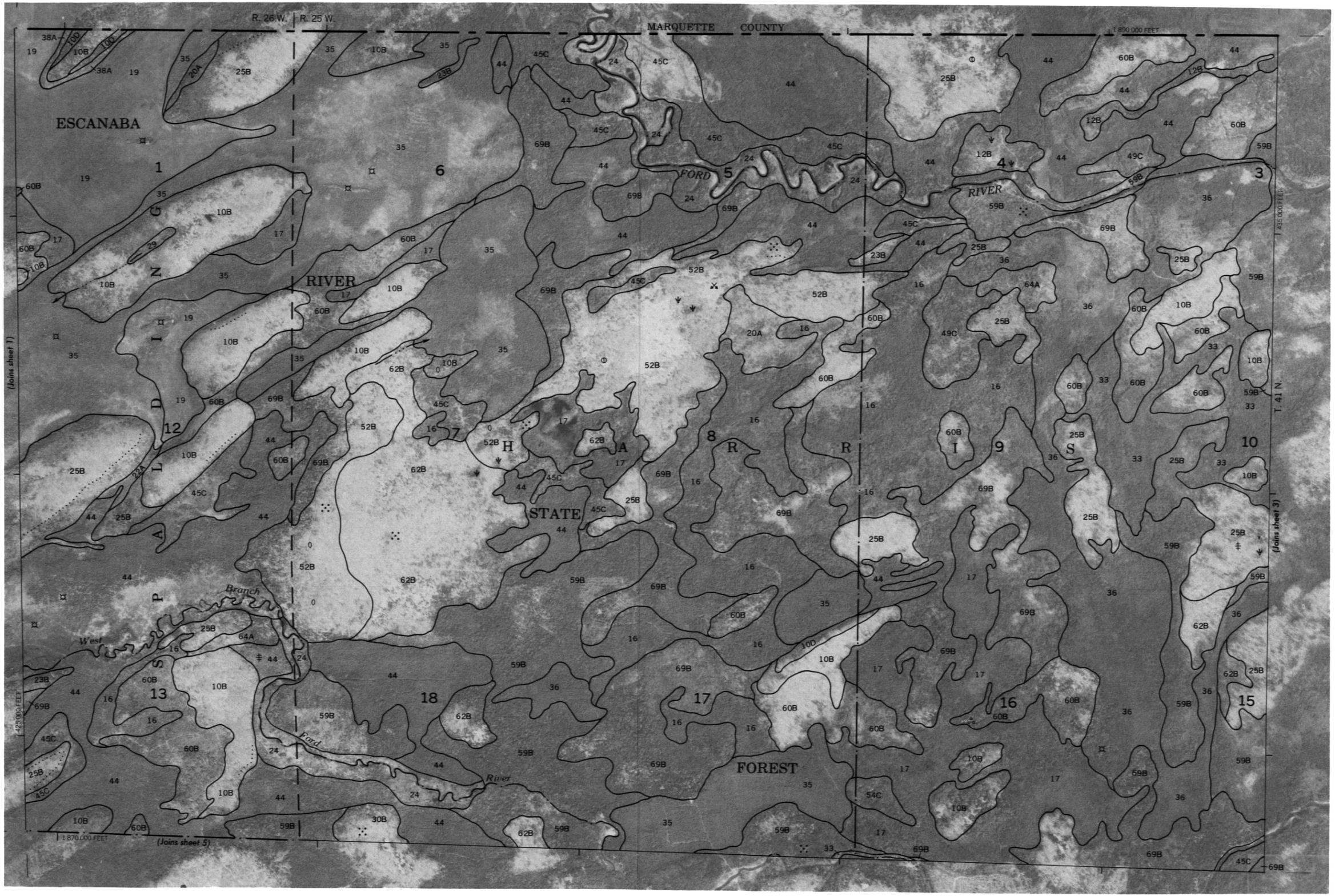
1 825 000 FEET

1 Mile

5000 Feet

Scale 1:20000

N



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MENOMINEE COUNTY MICHIGAN NO 2

MENOMINEE COUNTY, MICHIGAN — SHEET NUMBER 3

MENOMINEE COUNTY, MICHIGAN NO. 3

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

R. 25 W. MARQUETTE COUNTY

1 895 000 FEET

435 000 FEET

T. 41 N.

DELTA COUNTY

425 000 FEET

(Joins sheet 2)

(Joins sheet 6)

1 905 000 FEET

HARRISON RIVER

FORD RIVER

R. 26 W. MARQUETTE COUNTY

1 842 000 FEET

DICKINSON COUNTY

(Joins inset, sheet 6)

1 845 000 FEET

3000 AND 5000-FOOT GRID TICKS

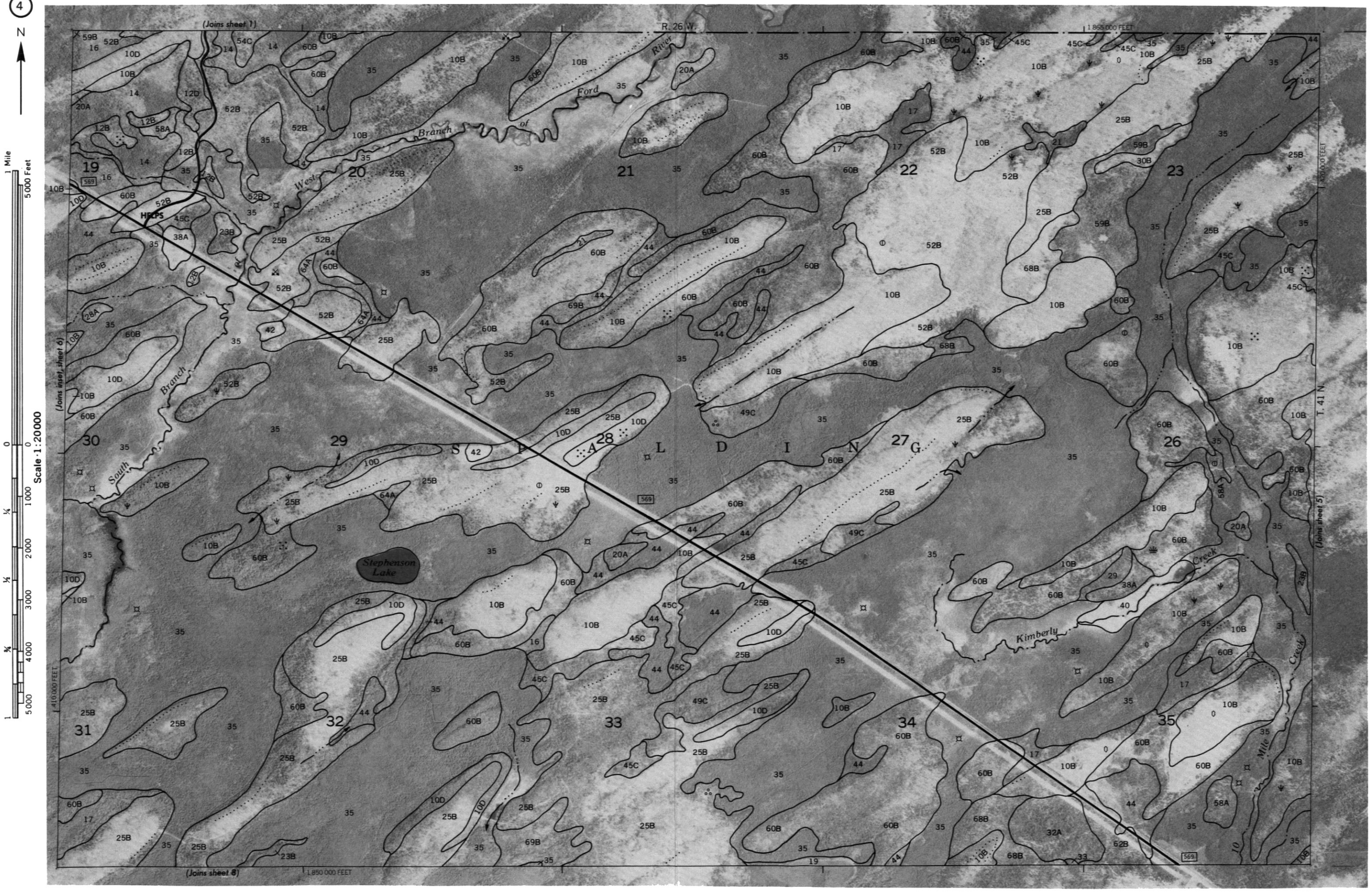
3

N

1 Mile

5000 Feet

Scale 1:20000



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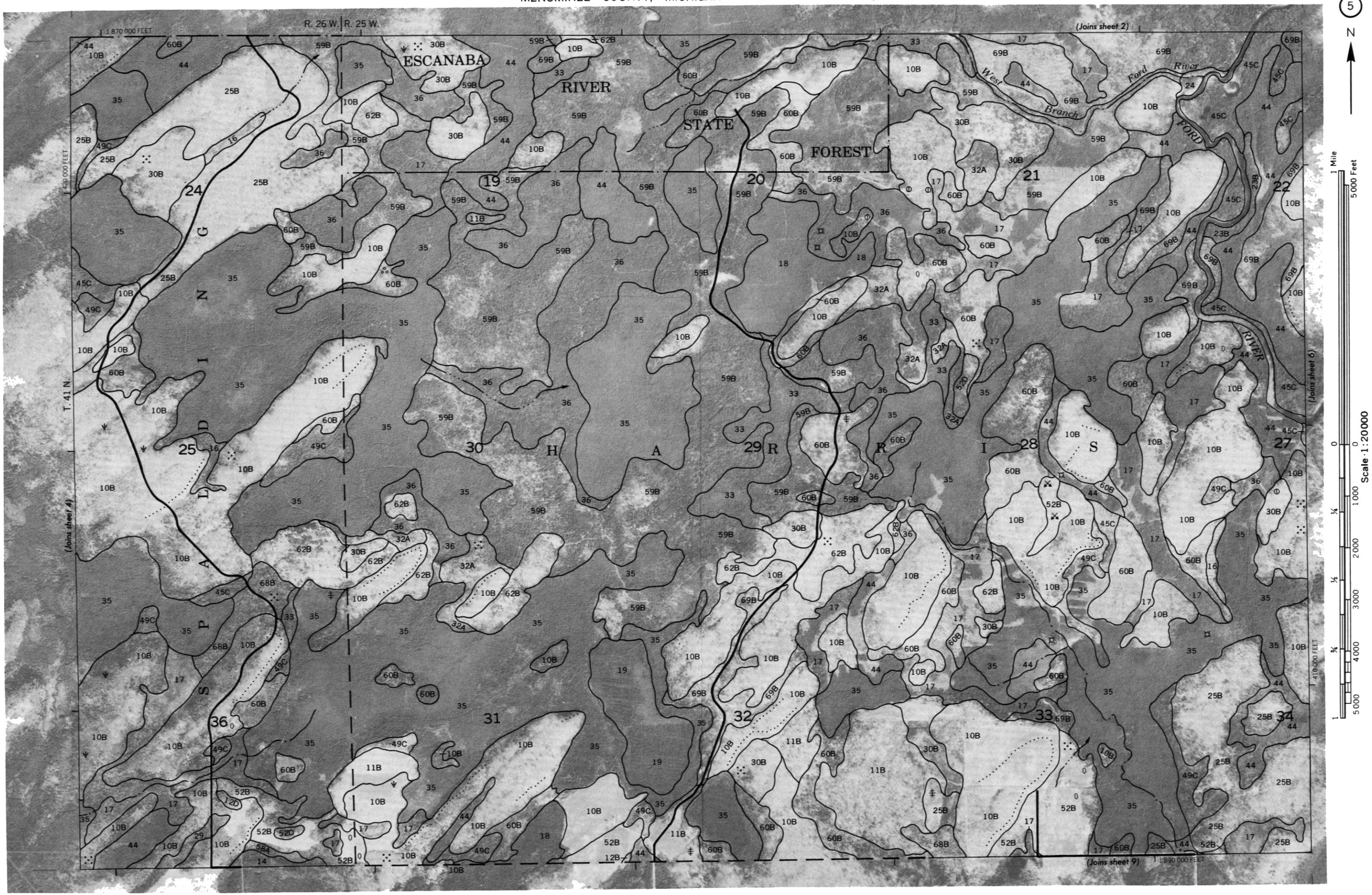
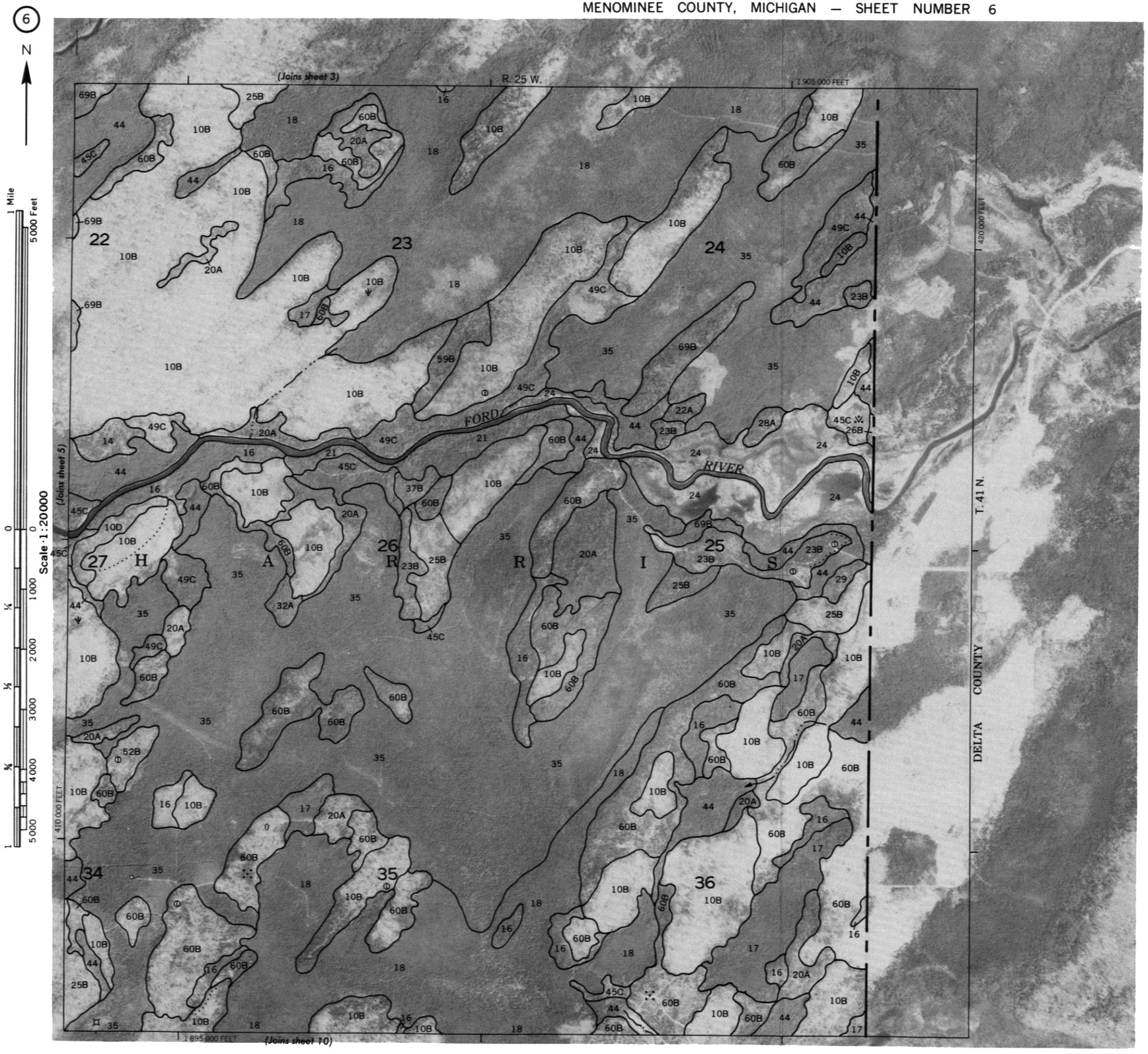
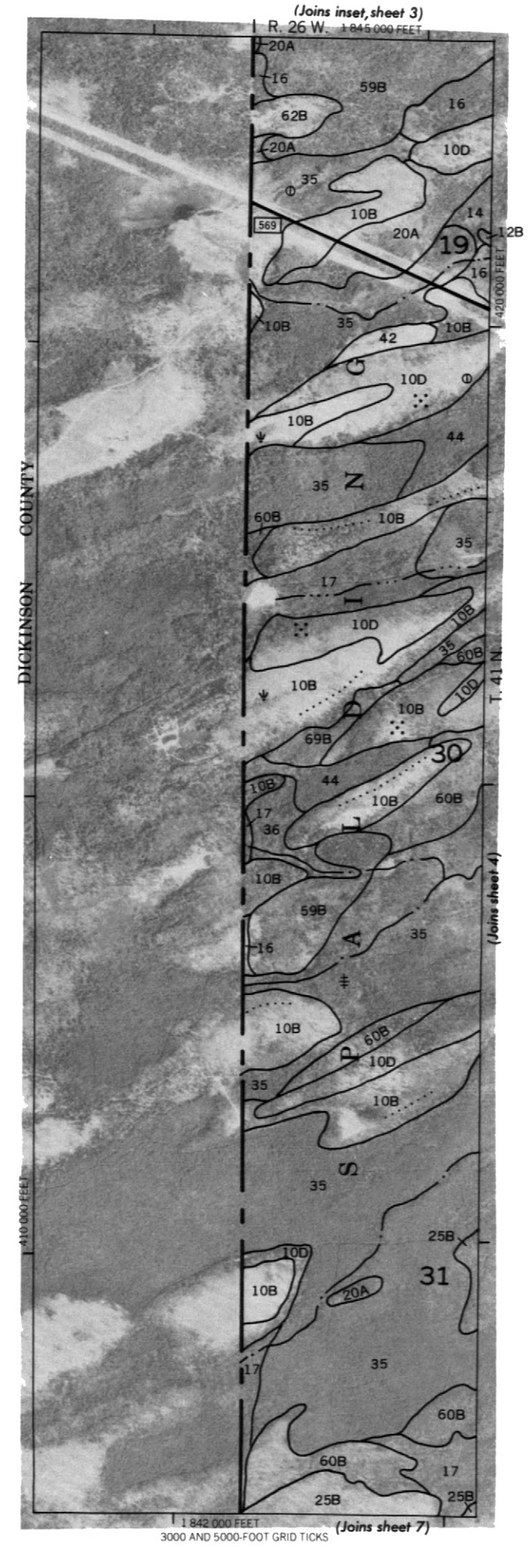
MENOMINEE COUNTY, MICHIGAN NO. 4



MENOMINEE COUNTY, MICHIGAN NO. 5

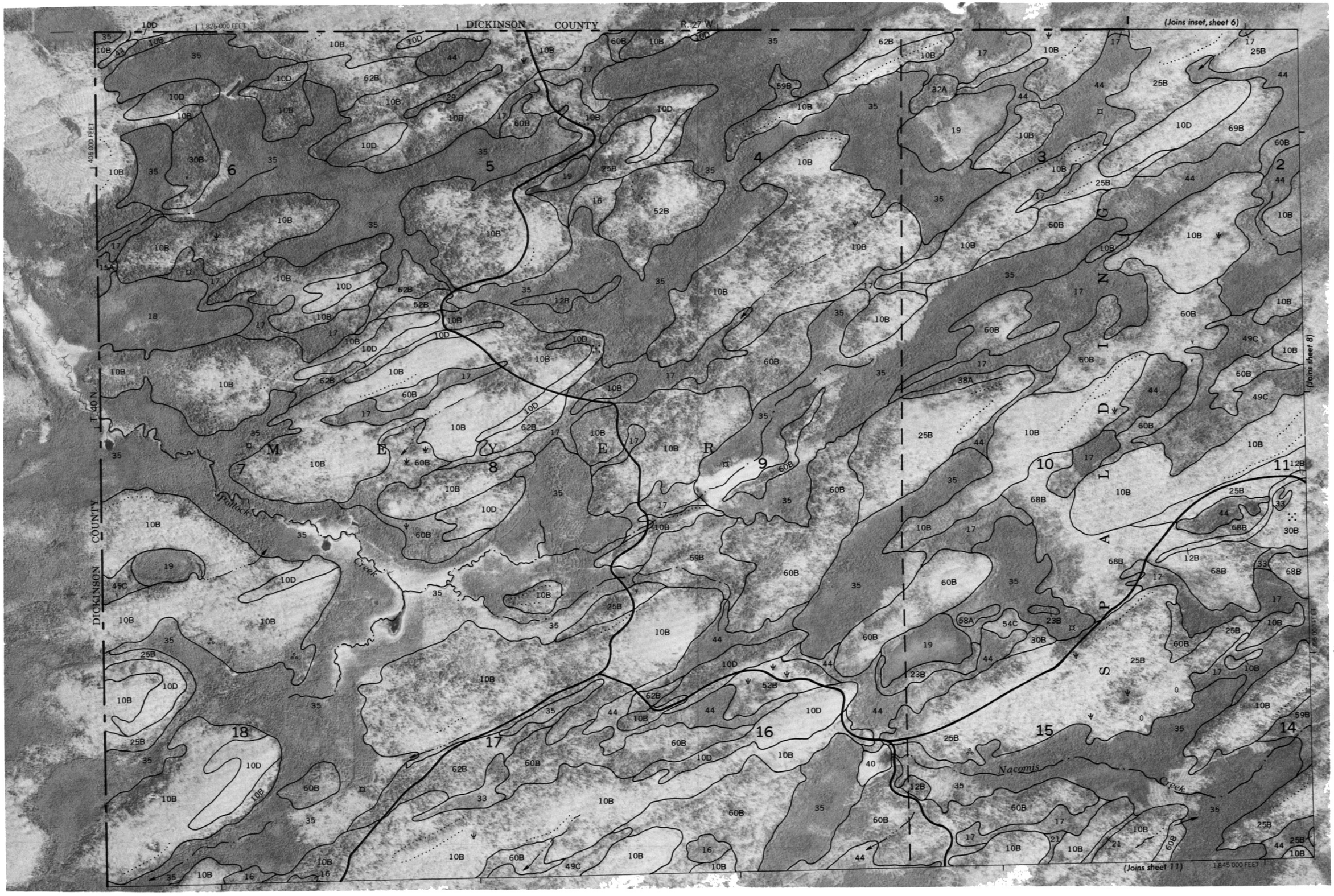
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 6



MENOMINEE COUNTY, MICHIGAN NO. 7

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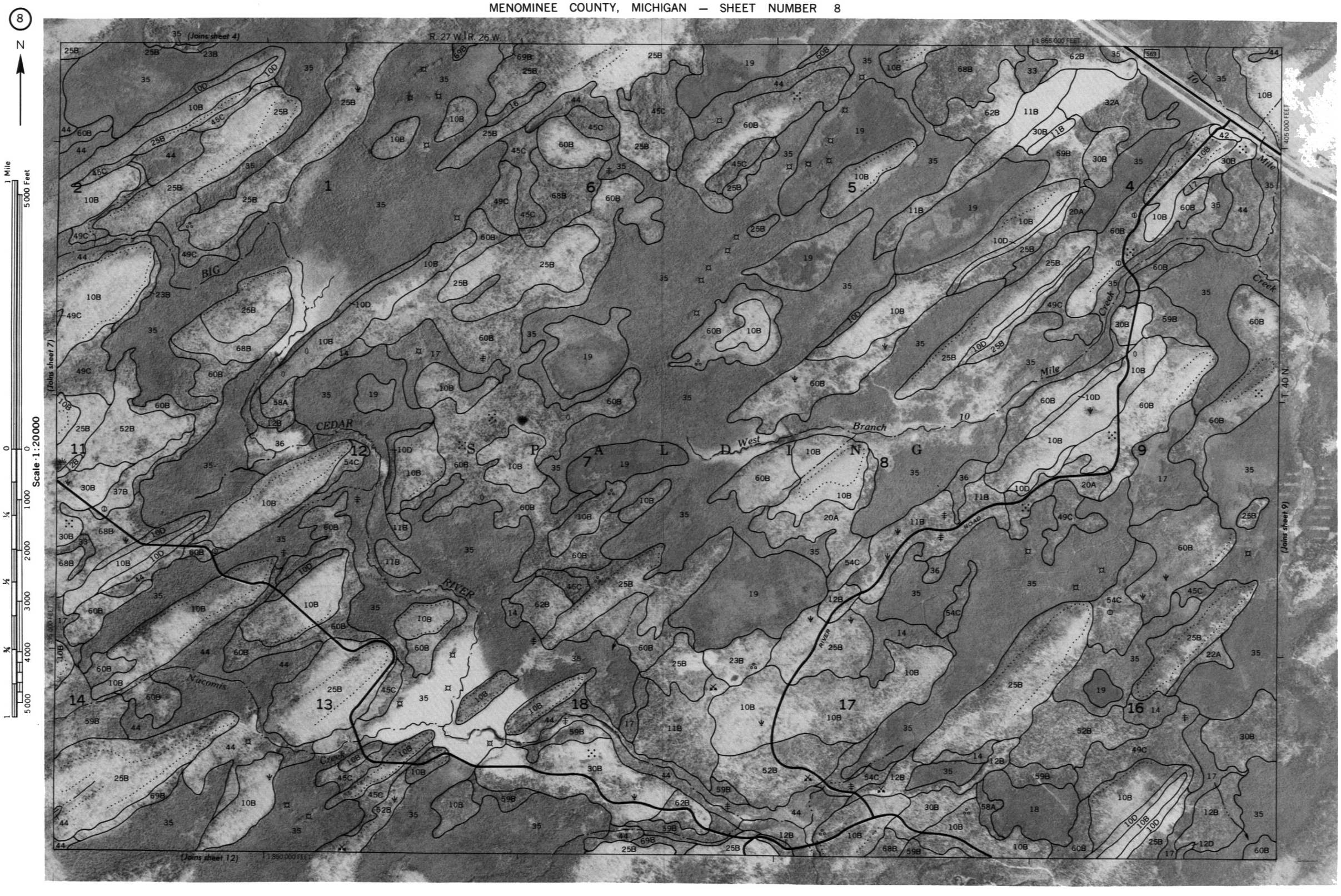
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

7

N

1 Mile
5000 Feet

Scale 1:20000



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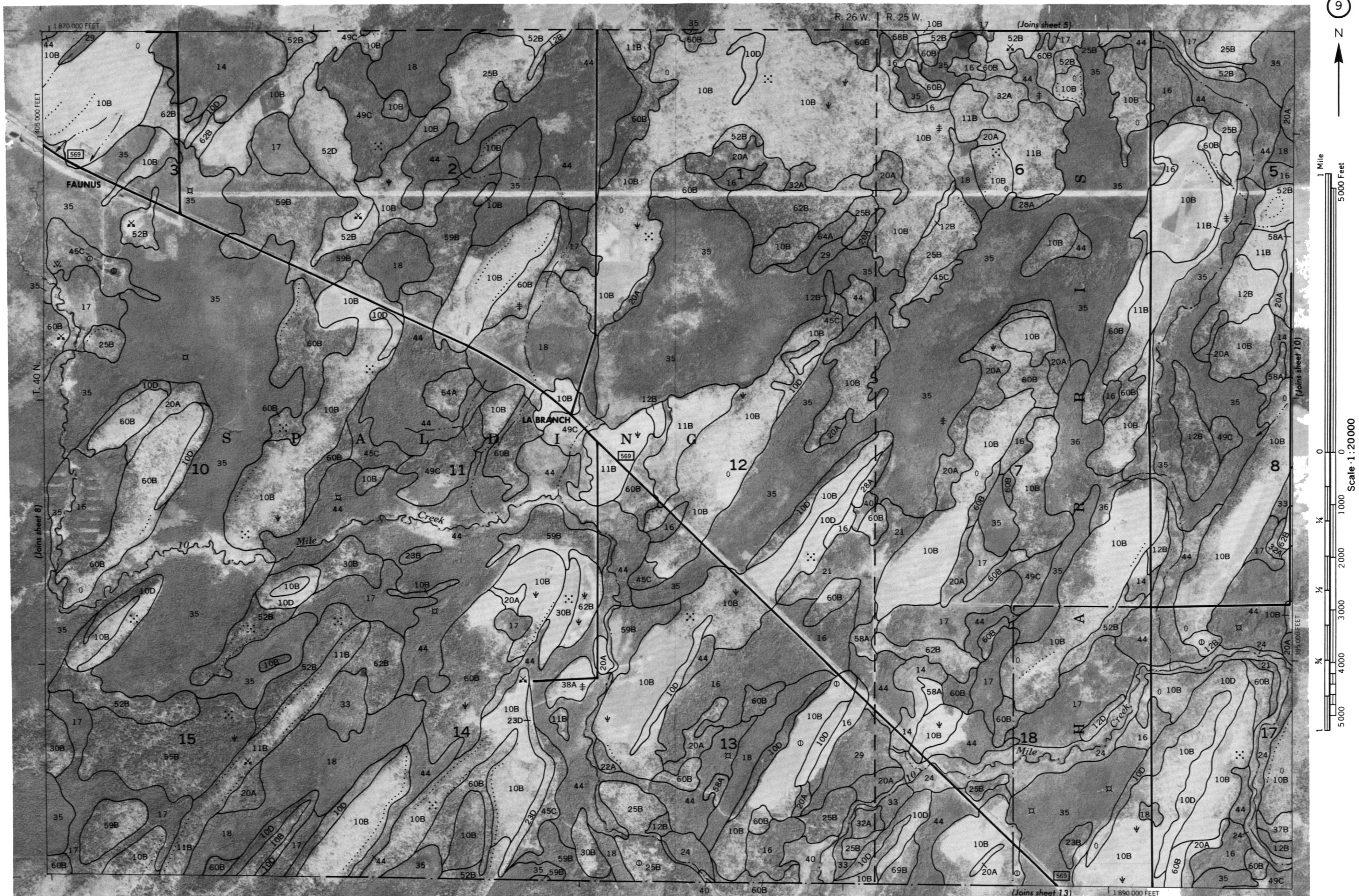
MENOMINEE COUNTY, MICHIGAN NO. 8



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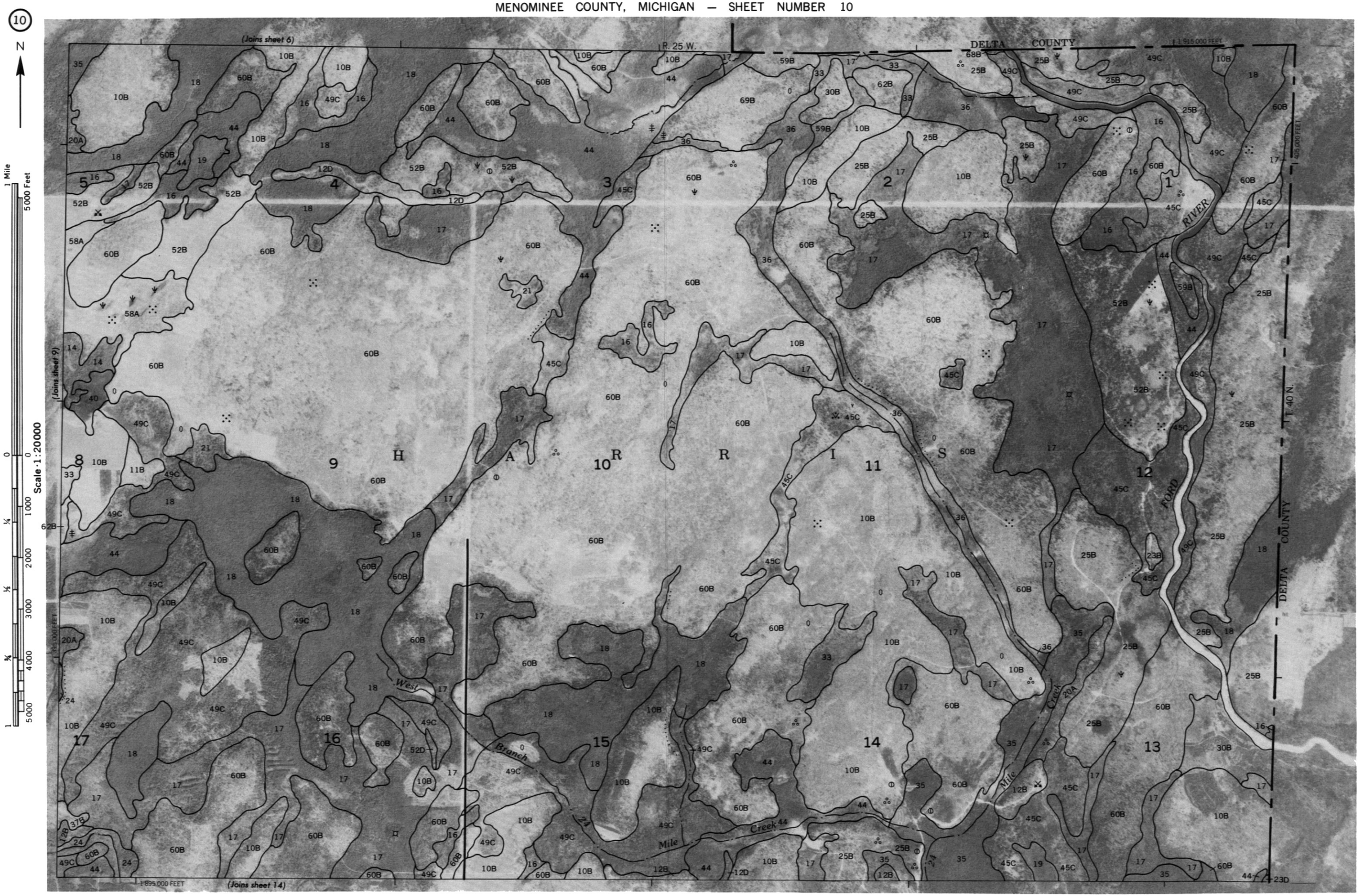

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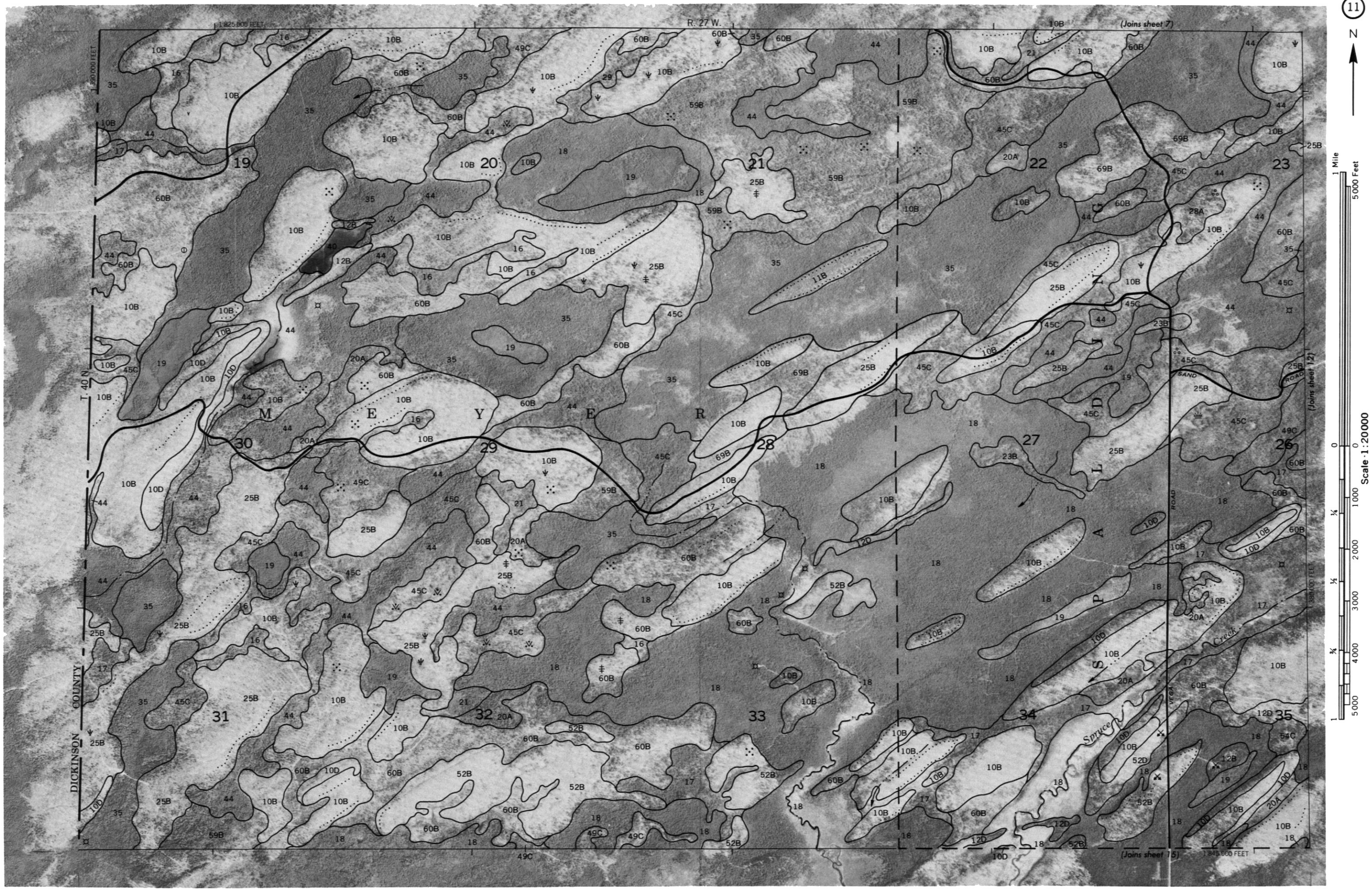
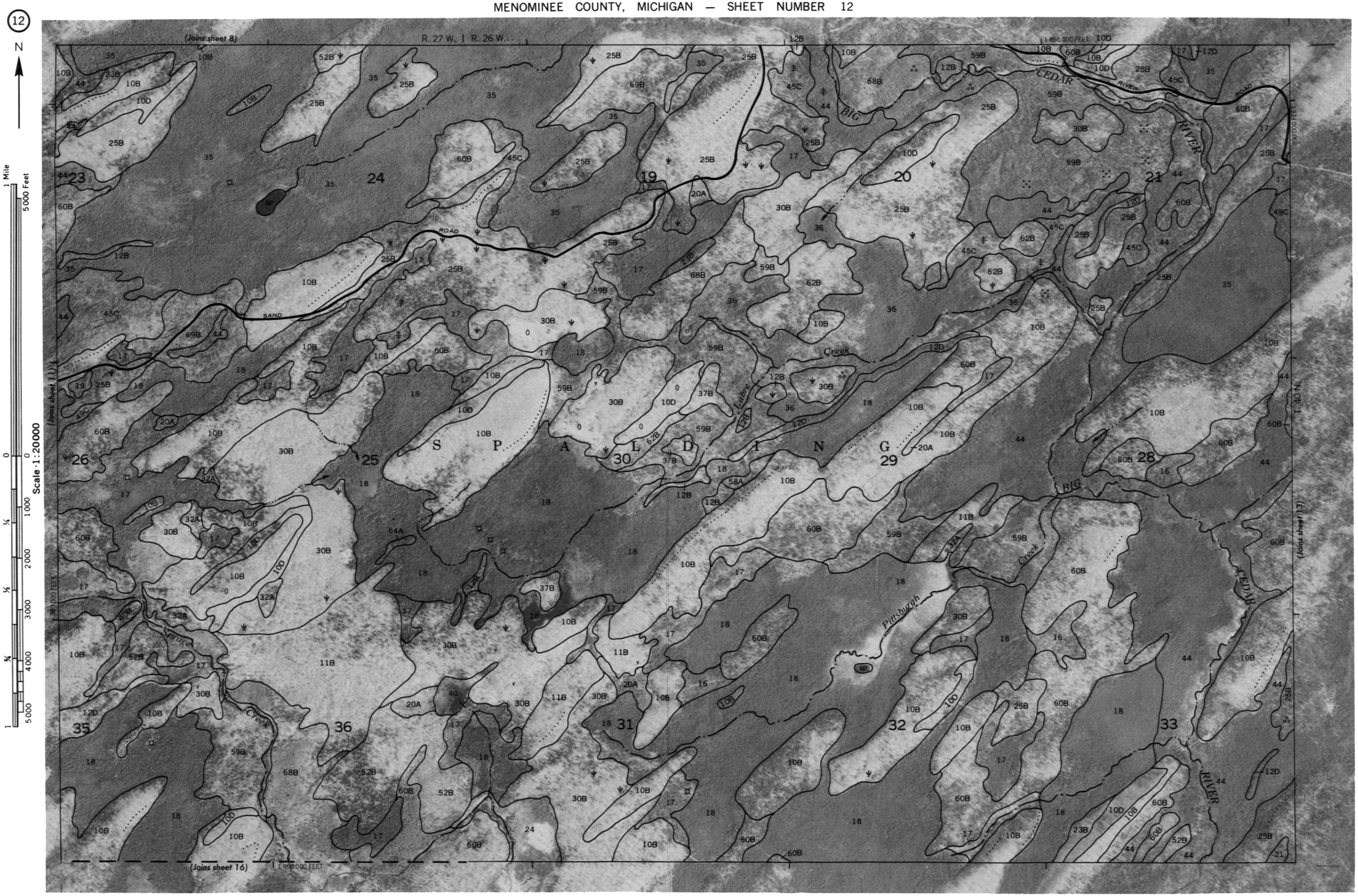
MENOMINEE COUNTY, MICHIGAN NO. 10



MENOMINEE COUNTY, MICHIGAN NO. 11

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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MENOMINEE COUNTY, MICHIGAN NO. 12

MENOMINEE COUNTY, MICHIGAN NO. 13

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

13

N

1 Mile
5000 Feet
0 0
Scale 1:20000
1 5000
½ 2500
¼ 1000
0 0

R. 26 W. R. 25 W.

1 870 000 FEET

390 000 FEET

360 000 FEET

1 890 000 FEET

T. 40 N.

(Joins sheet 9)

(Joins sheet 14)

(Joins sheet 12)

(Joins sheet 17)

ESCANABA

RIVER

Oliver Lake

Creek

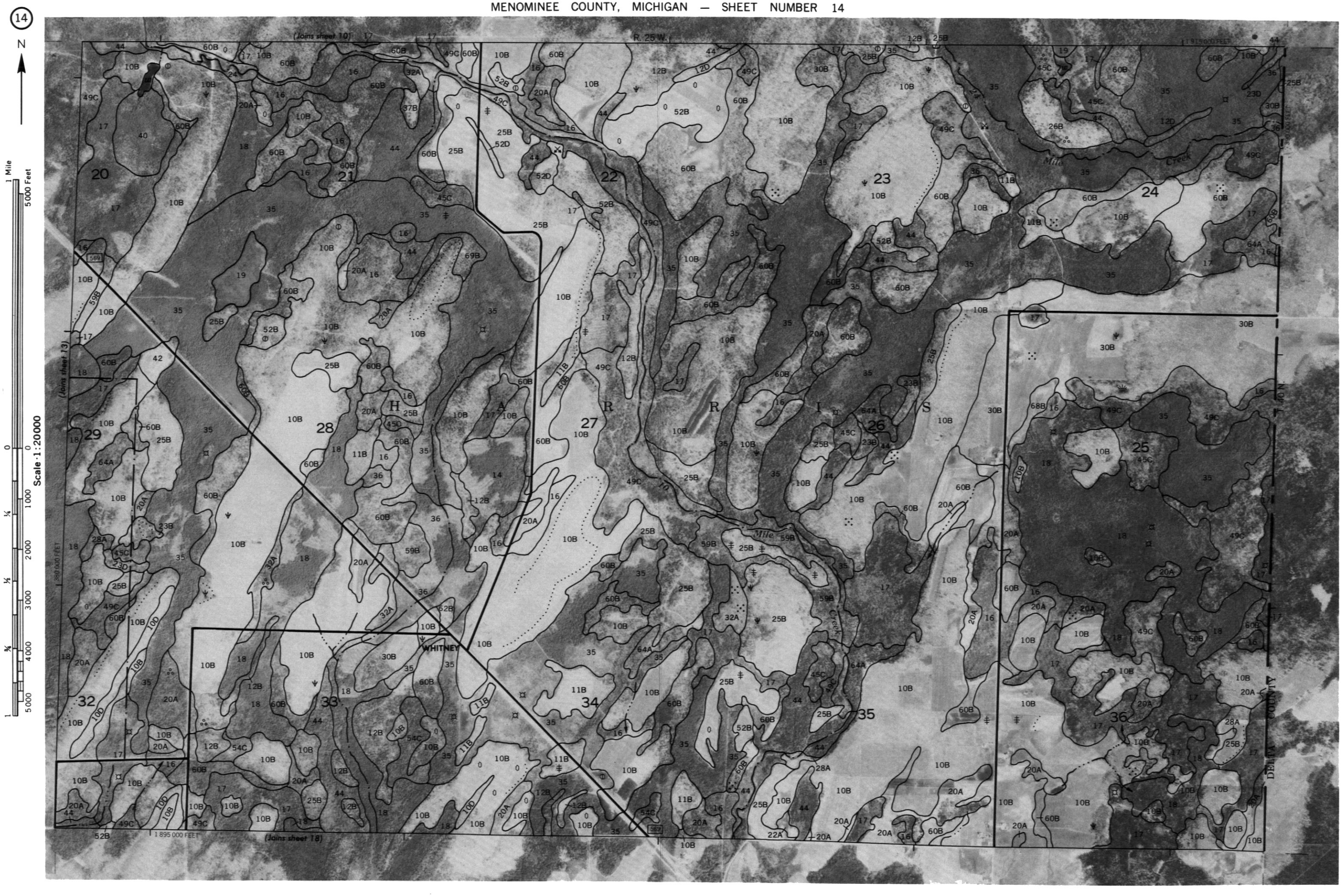
Mile

STATE FOREST

Road

River

22 23 24 19 20 27 26 25 30 29 34 35 36 31 32



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MENOMINEE COUNTY, MICHIGAN NO. 14

MENOMINEE COUNTY, MICHIGAN NO. 15

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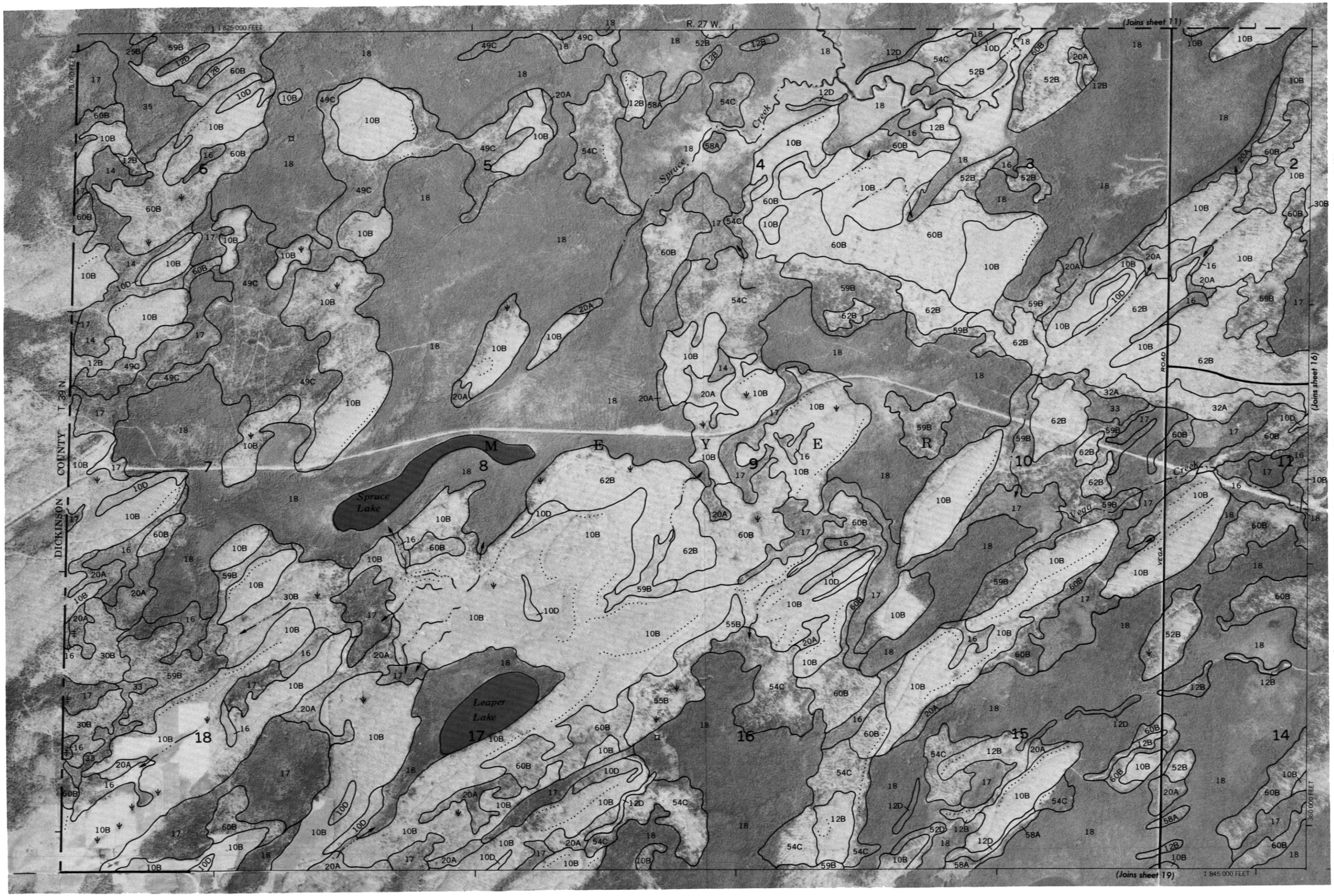

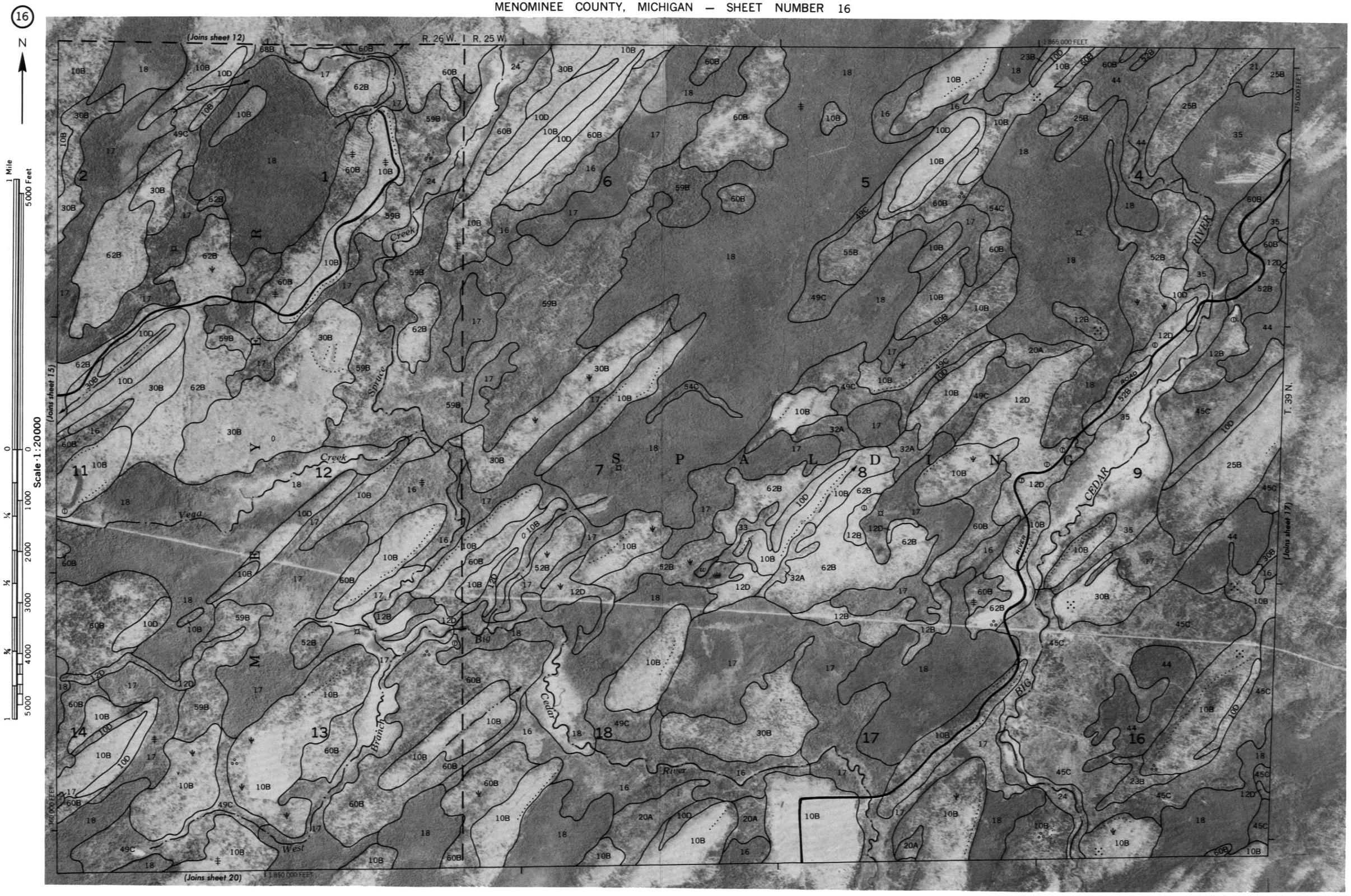

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MENOMINEE COUNTY, MICHIGAN NO. 16

MENOMINEE COUNTY, MICHIGAN NO. 17

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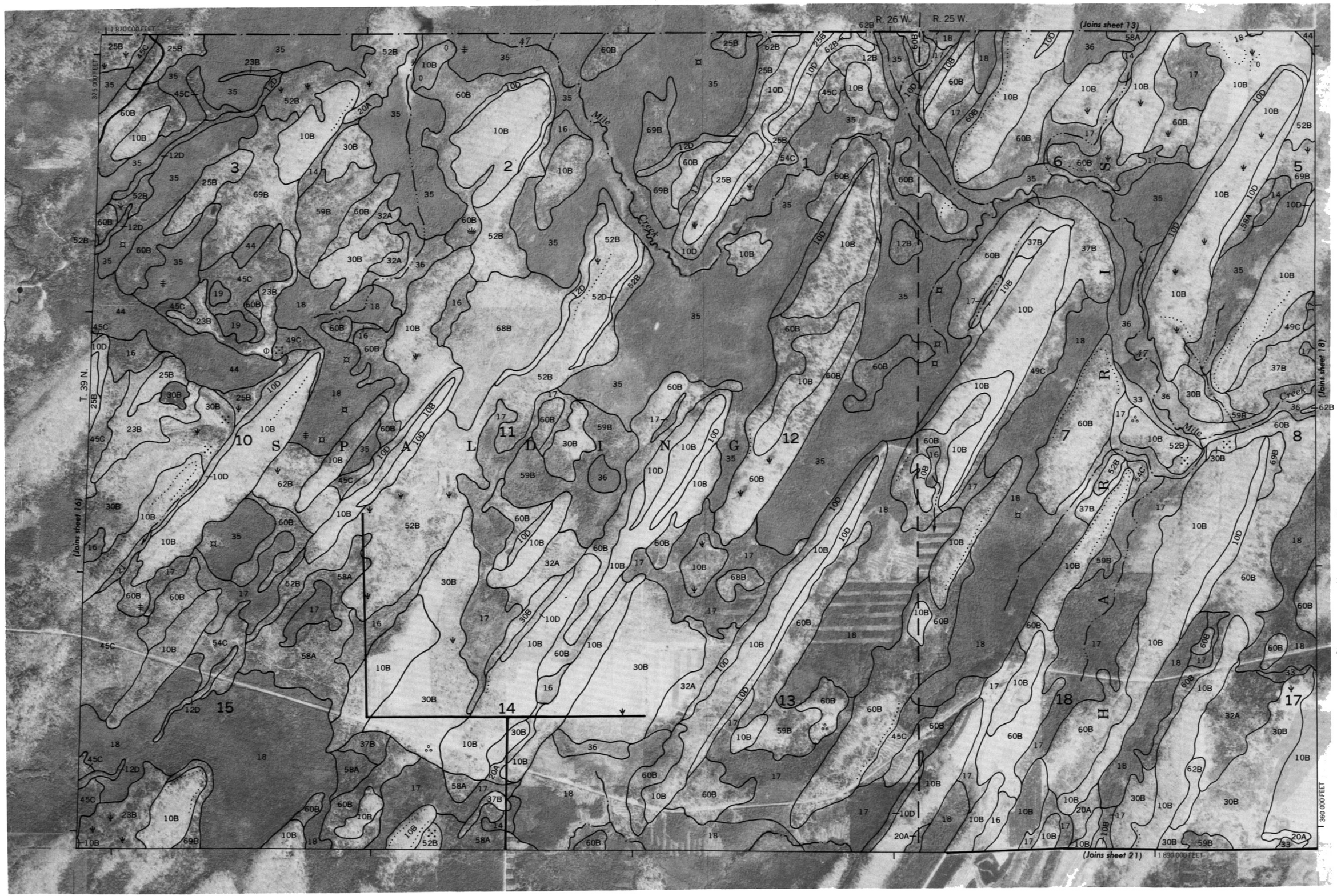
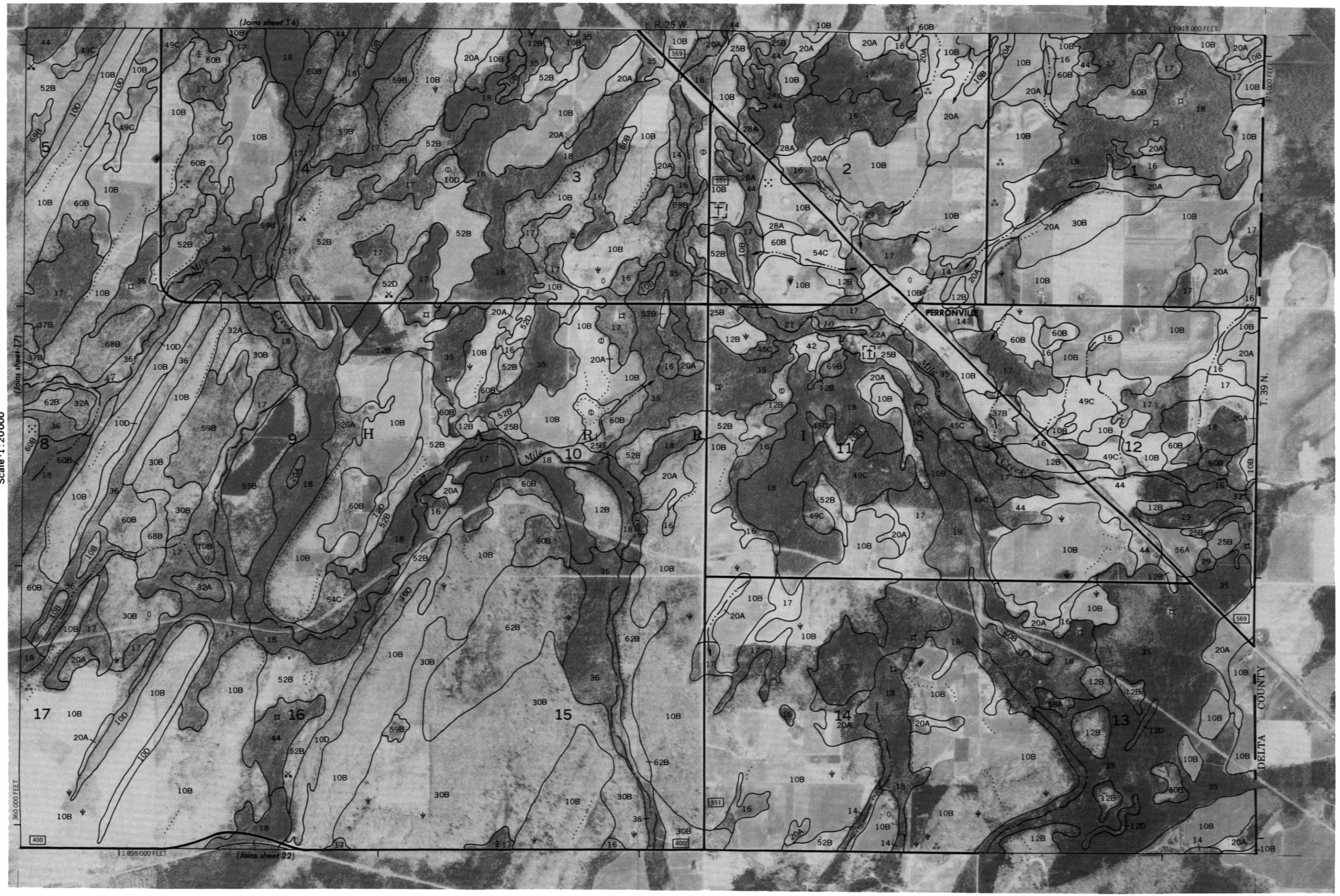


17

N

1 Mile
5000 Feet

Scale · 1:20000



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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 18

MENOMINEE COUNTY, MICHIGAN NO. 19

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

19

N

1 Mile

5,000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

1 825 000 FEET

1 845 000 FEET

T. 39 N.

R. 27 W.

(Joins sheet 15)

(Joins sheet 20)

(Joins sheet 25)

Lake Eighteen

Little Cedar River

Beaver Dam Creek

CHICAGO AND NORTHWESTERN

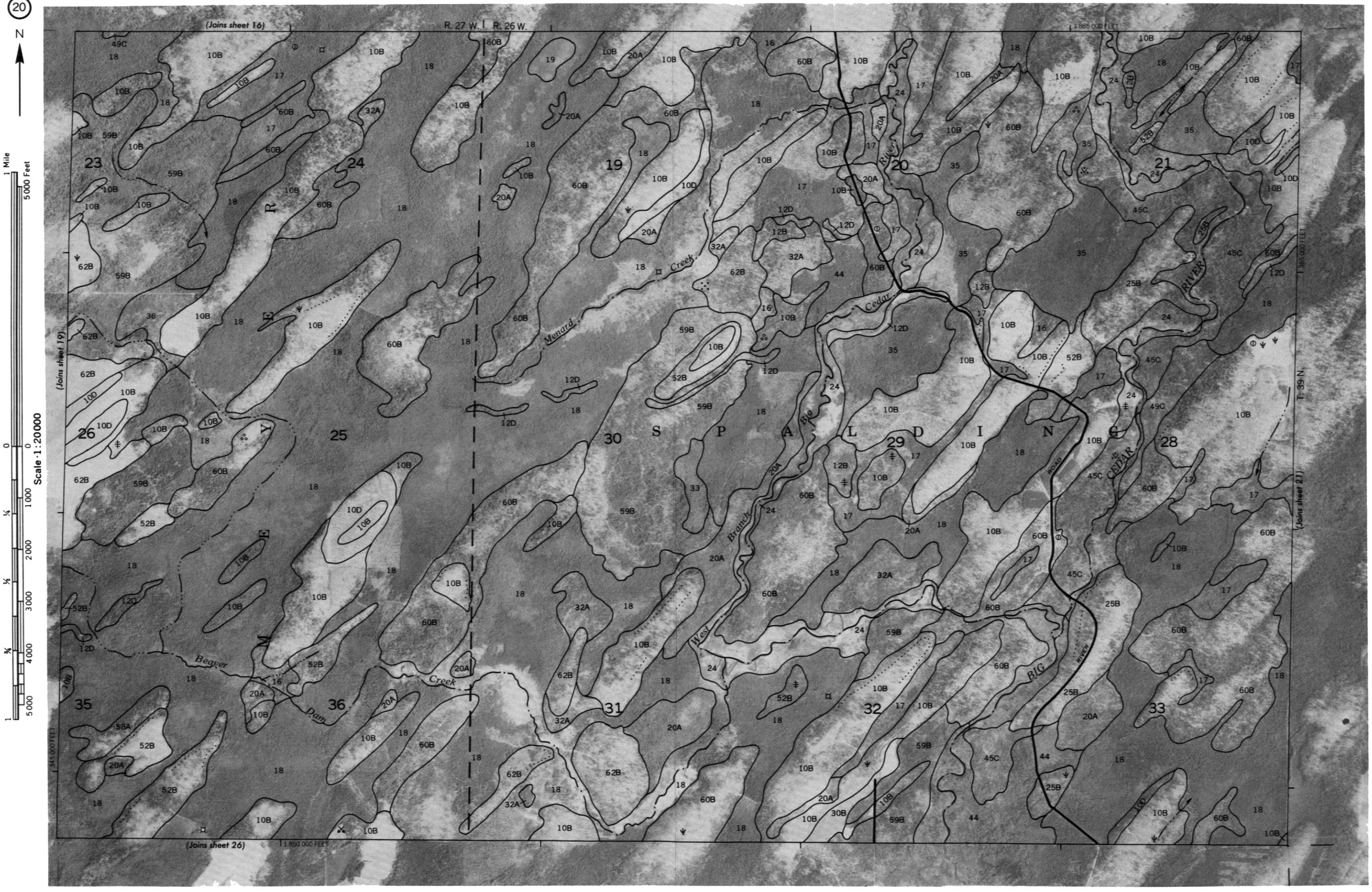
CUNARD

VEGA ROAD

DICKINSON COUNTY

579

19 20 21 22 23 26 27 28 29 30 31 32 33 34 35



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MENOMINEE COUNTY, MICHIGAN — SHEET NUMBER 21

MENOMINEE COUNTY, MICHIGAN NO. 21

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

R. 26 W. | R. 25 W.

T. 39 N.

(Joins sheet 20)

(Joins sheet 17)

(Joins sheet 22)

(Joins sheet 27)

1 870 000 FEET

395 000 FEET

345 000 FEET

1 890 000 FEET

SPALDING

Little Indian Lake

Big Indian Lake

Indian Creek

Wilson Creek

Scale 1:20000

1 Mile

5000 Feet

N

MENOMINEE COUNTY, MICHIGAN — SHEET NUMBER 22

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MENOMINEE COUNTY, MICHIGAN NO. 22

MENOMINEE COUNTY, MICHIGAN NO. 23

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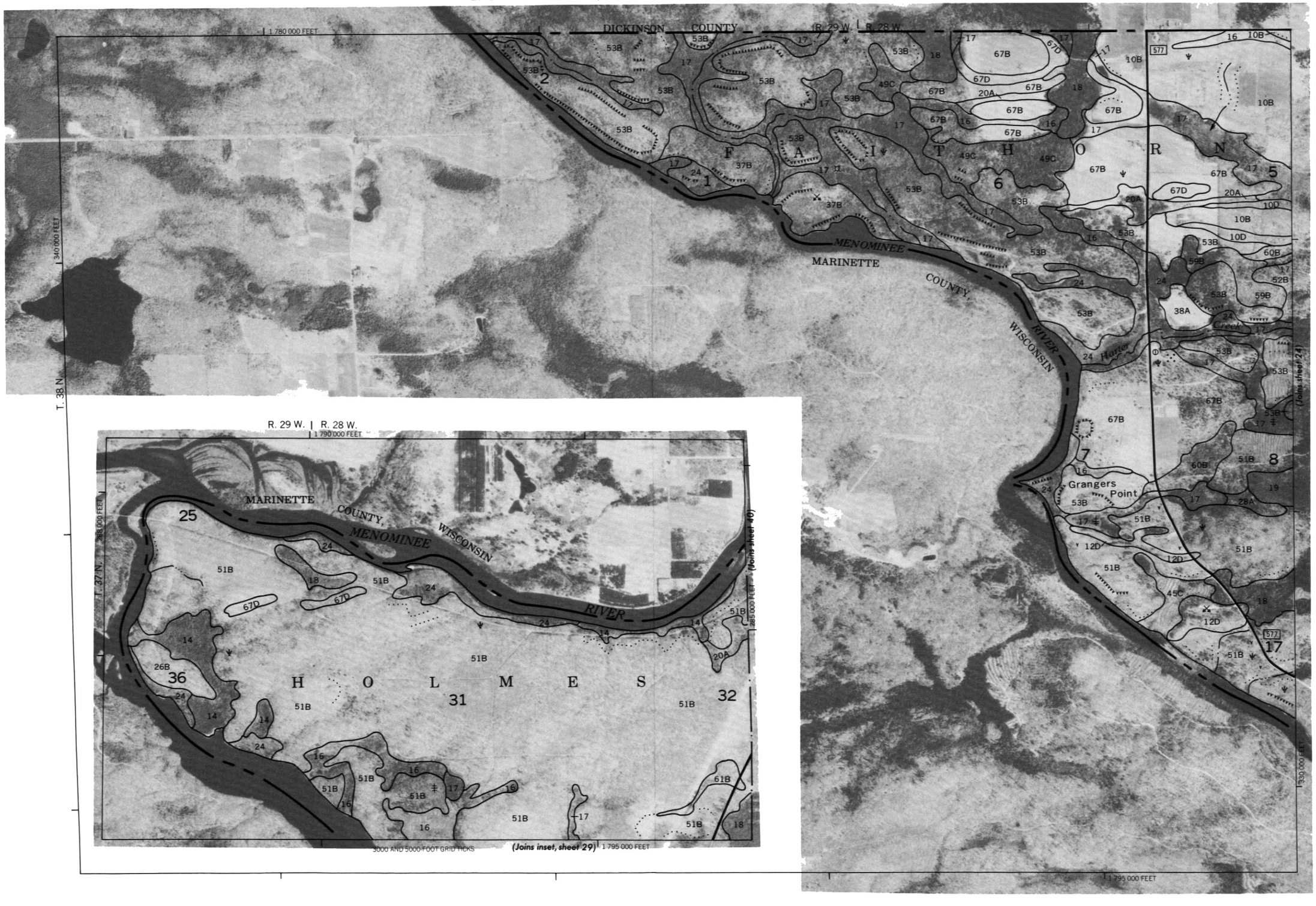

(Joins sheet 24)

23

N

1 Mile
5000 Feet

Scale 1:20000

24

N

R. 28 W.

DICKINSON COUNTY

T. 38 N.

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 30)

1 820 000 FEET

340 000 FEET

330 000 FEET

1 800 000 FEET

MARINETTE COUNTY, WISCONSIN

MENOMINEE COUNTY

Harter Creek

Curson Creek

Mullen Creek

Faithorn Creek

FAITHORN

SOO LINE

MENOMINEE RIVER

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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MENOMINEE COUNTY, MICHIGAN NO. 24

MENOMINEE COUNTY, MICHIGAN NO. 25

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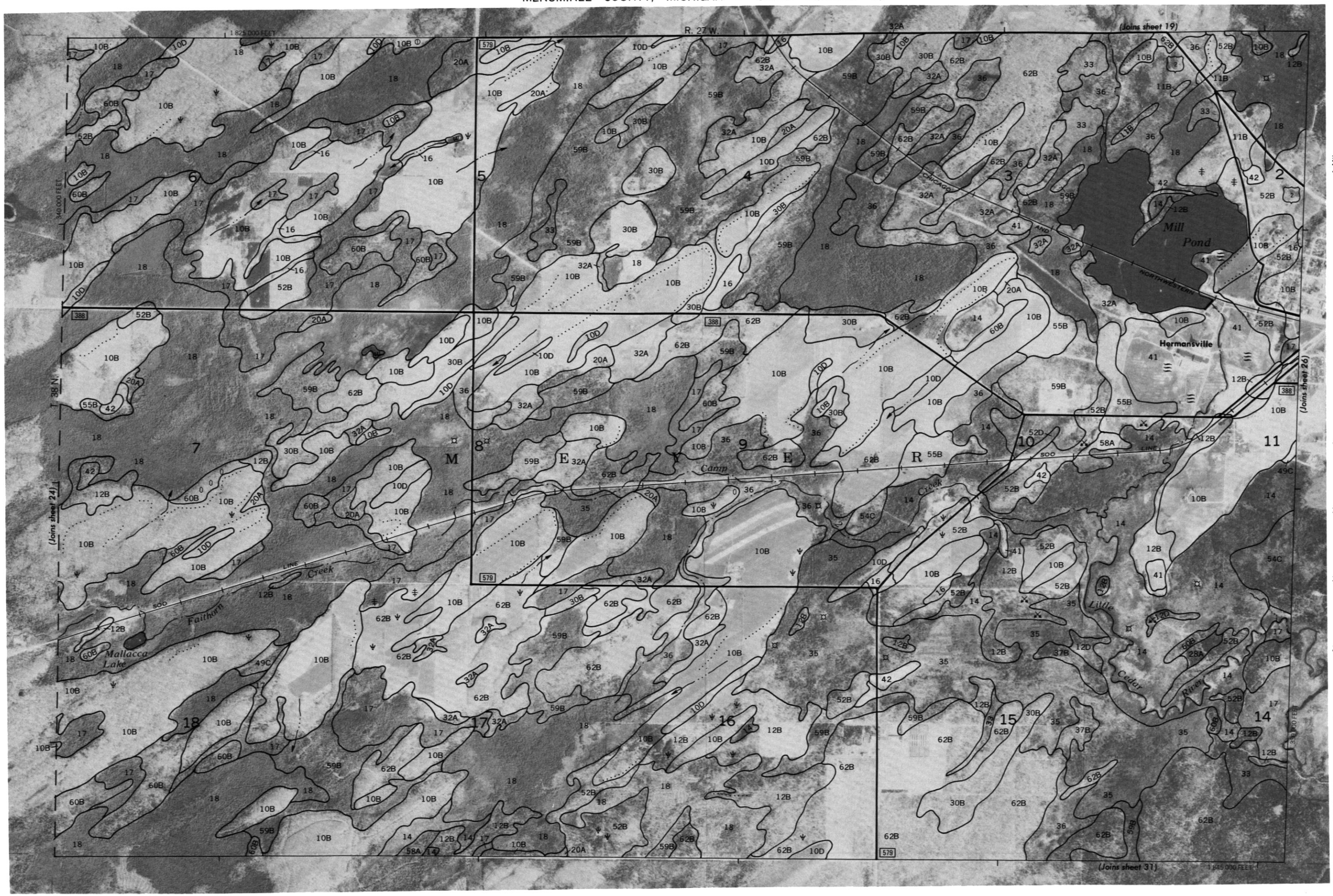

25

N

1 Mile
5000 Feet

Scale 1:20000

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MENOMINEE COUNTY, MICHIGAN NO. 26

MENOMINEE COUNTY, MICHIGAN NO. 27

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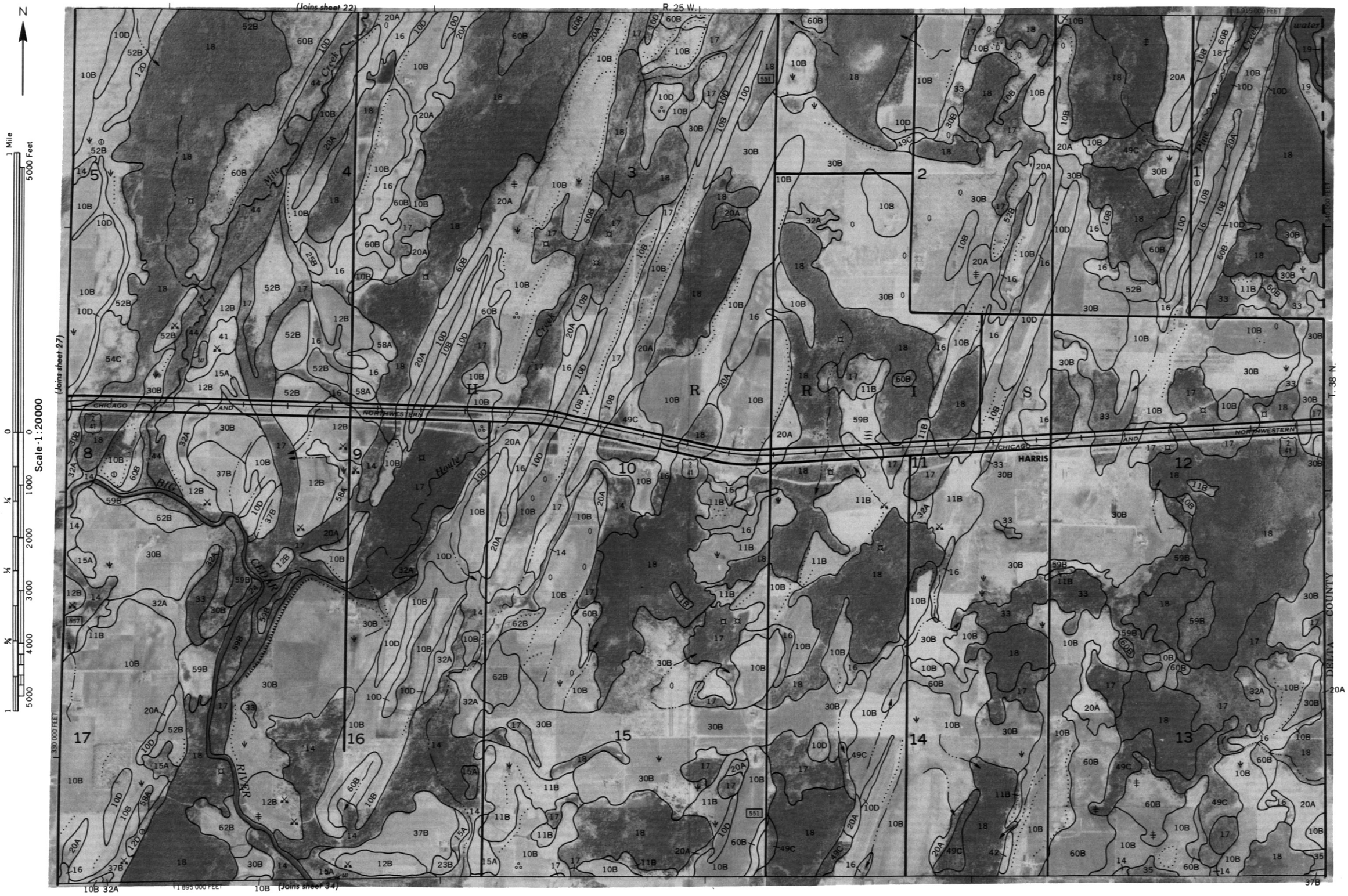

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MENOMINEE COUNTY, MICHIGAN NO. 28

MENOMINEE COUNTY, MICHIGAN NO. 29

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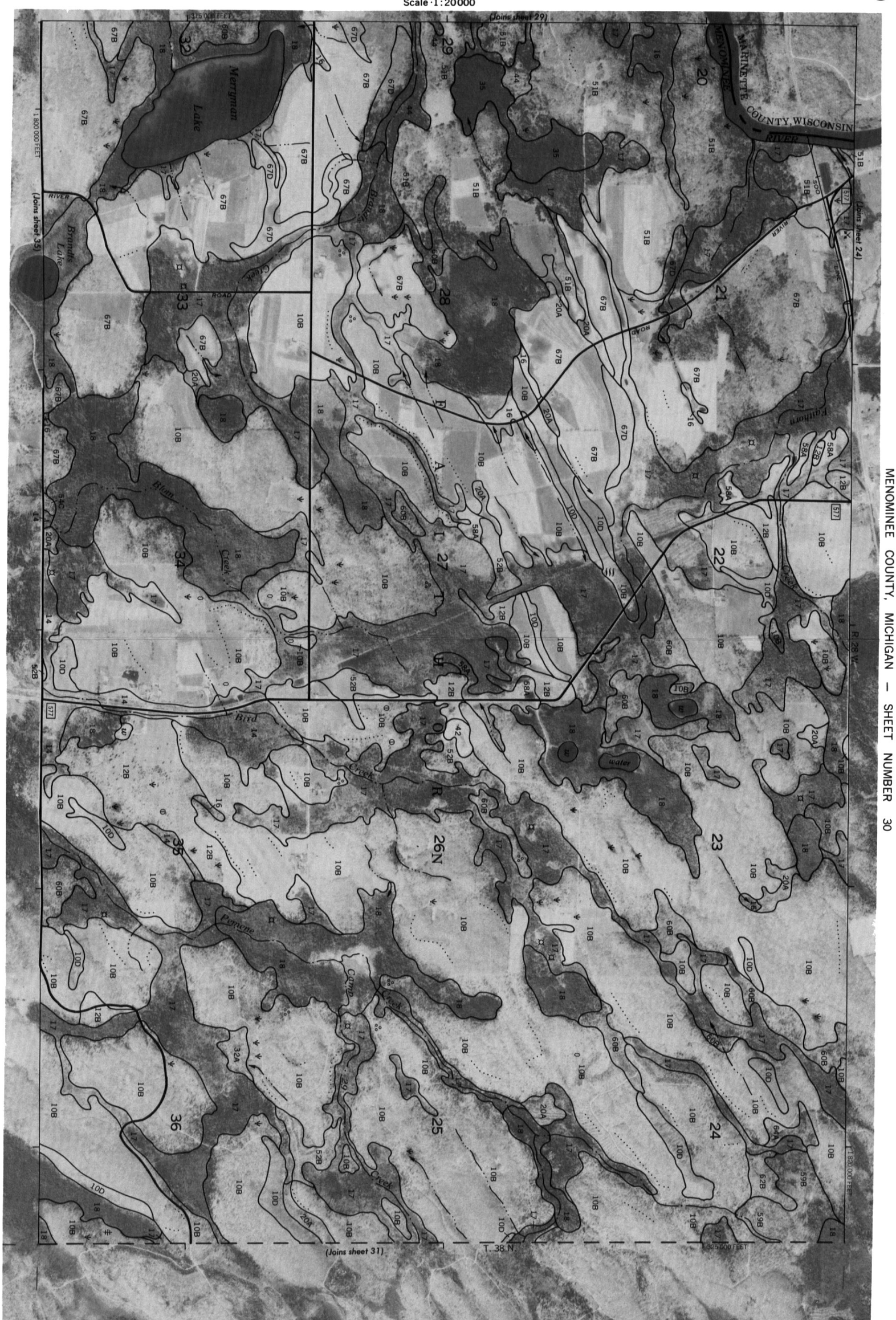
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

R. 29 W. | R. 28 W.
1 790 000 FEET
280 000 FEET
T. 36 N.
(Joins inset, sheet 23)
(Joins inset, sheet 45)
1 795 000 FEET
(Joins inset, sheet 50)
Chalk Hill
Goodman Brook
MARINETTE
MENOMINEE
COUNTY, WISCONSIN
RIVER
ROAD
water
Chalk Hill Dam
Saunders Creek
SUMMIT
OAKLAND
51B
12B
20A
61B
18
58A
53B
67B
67D
12D
22A
37B
60B
23B
53B
20
19
30
25
29
31
32
36
Quiver Falls
Brandis Creek
(Joins inset, sheet 30)
(Joins inset, sheet 57)

29
N
1 Mile
5000 Feet
Scale 1:20000



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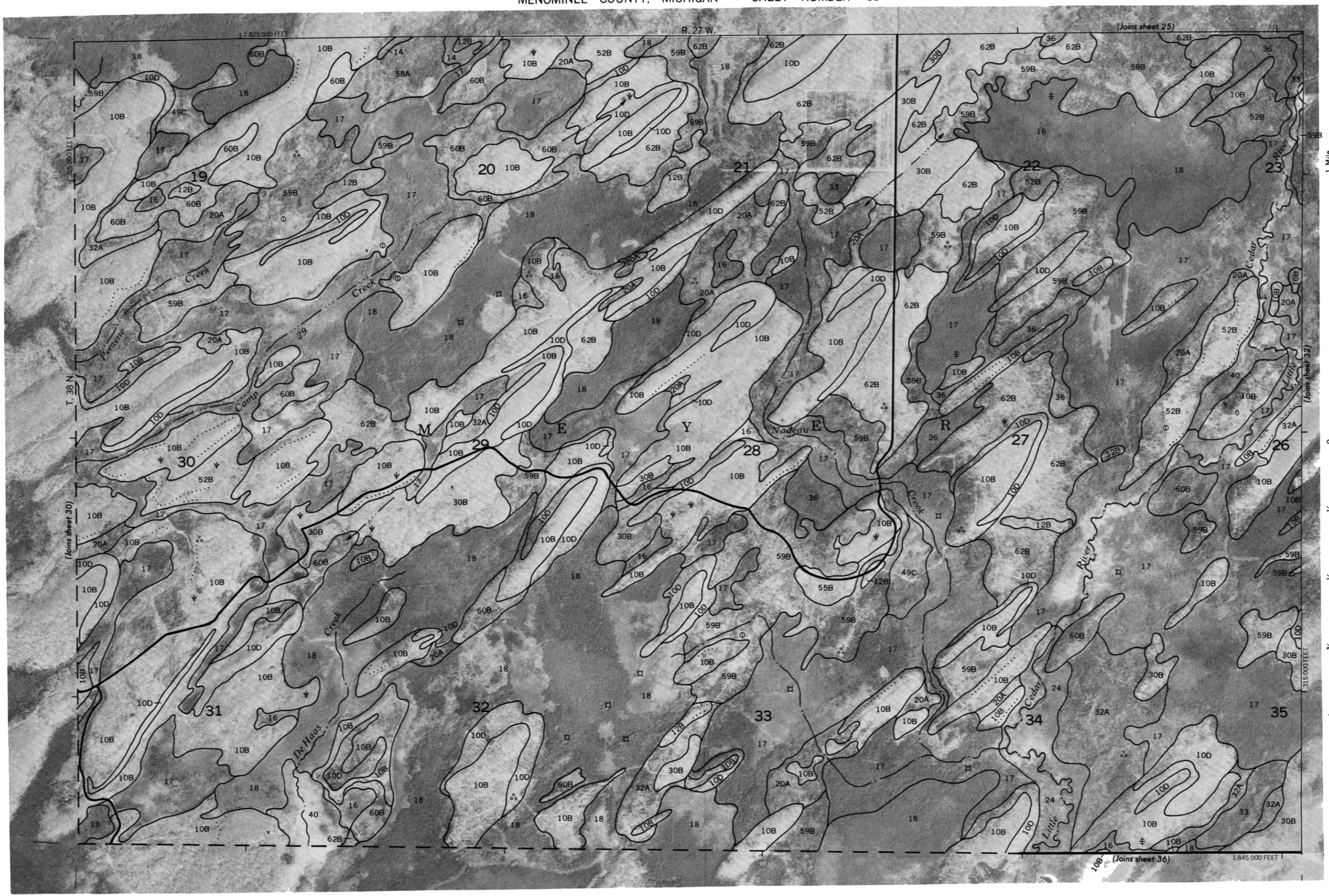
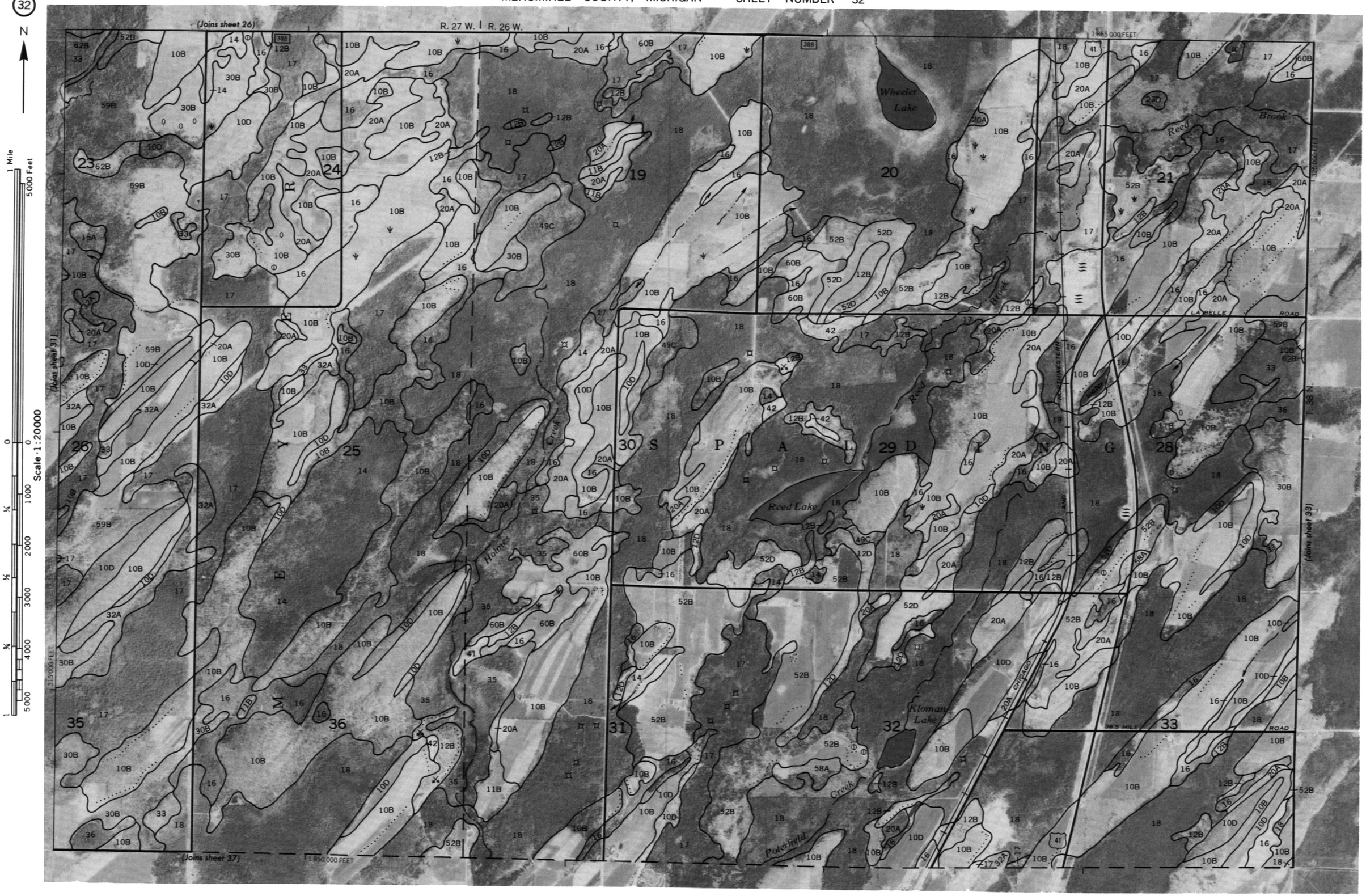
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 30



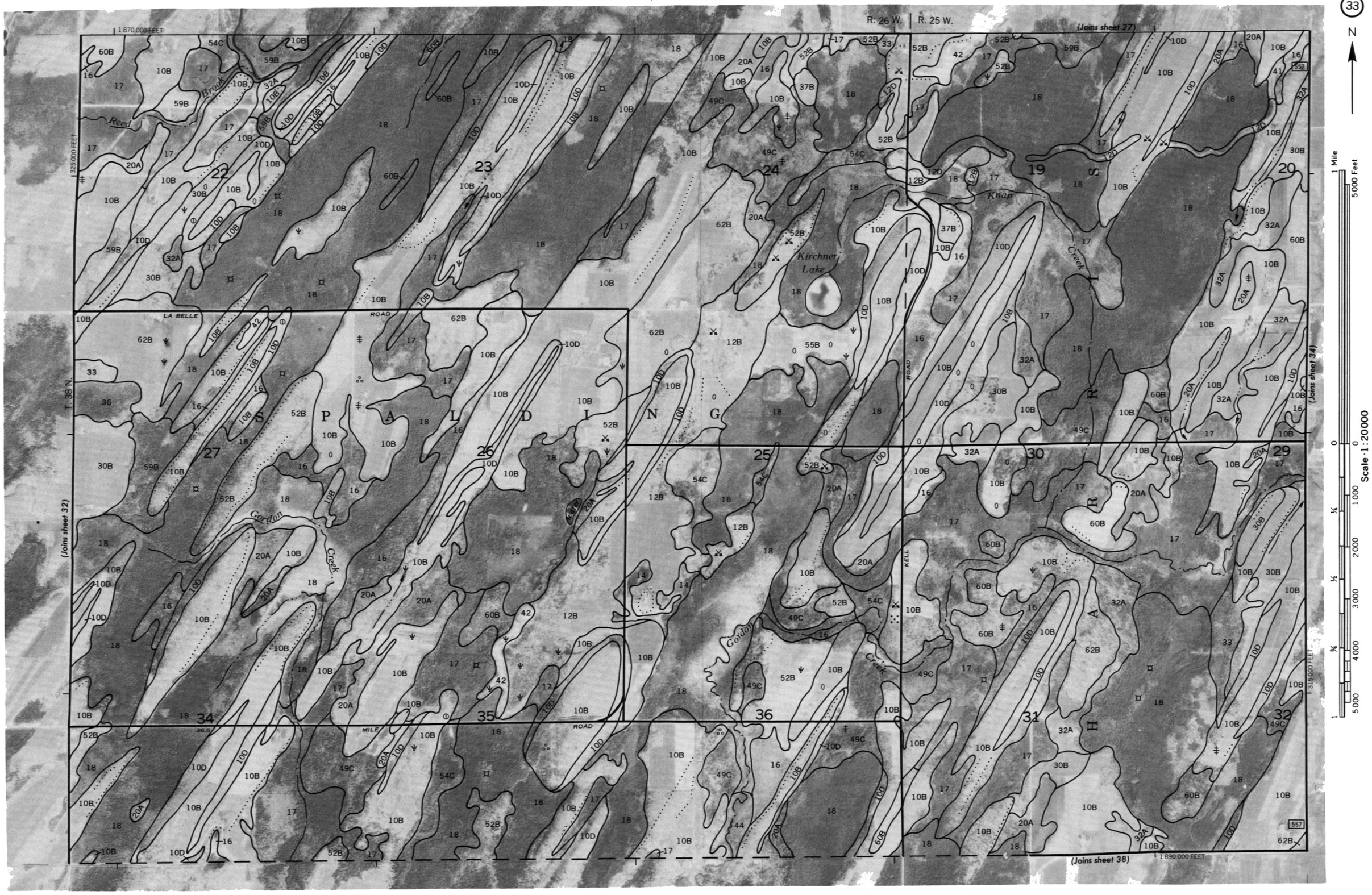
MENOMINEE COUNTY, MICHIGAN NO. 31

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



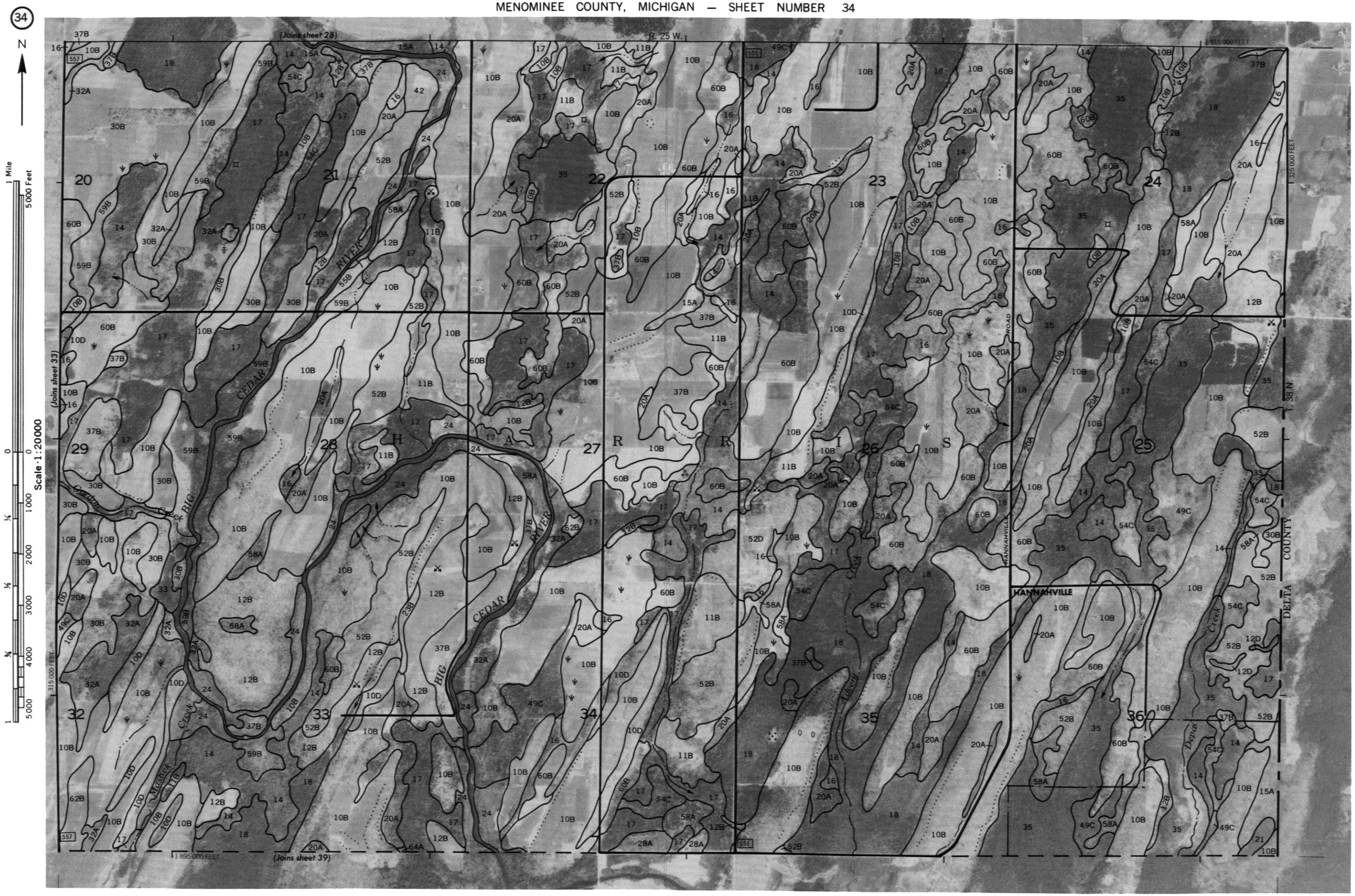
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 32

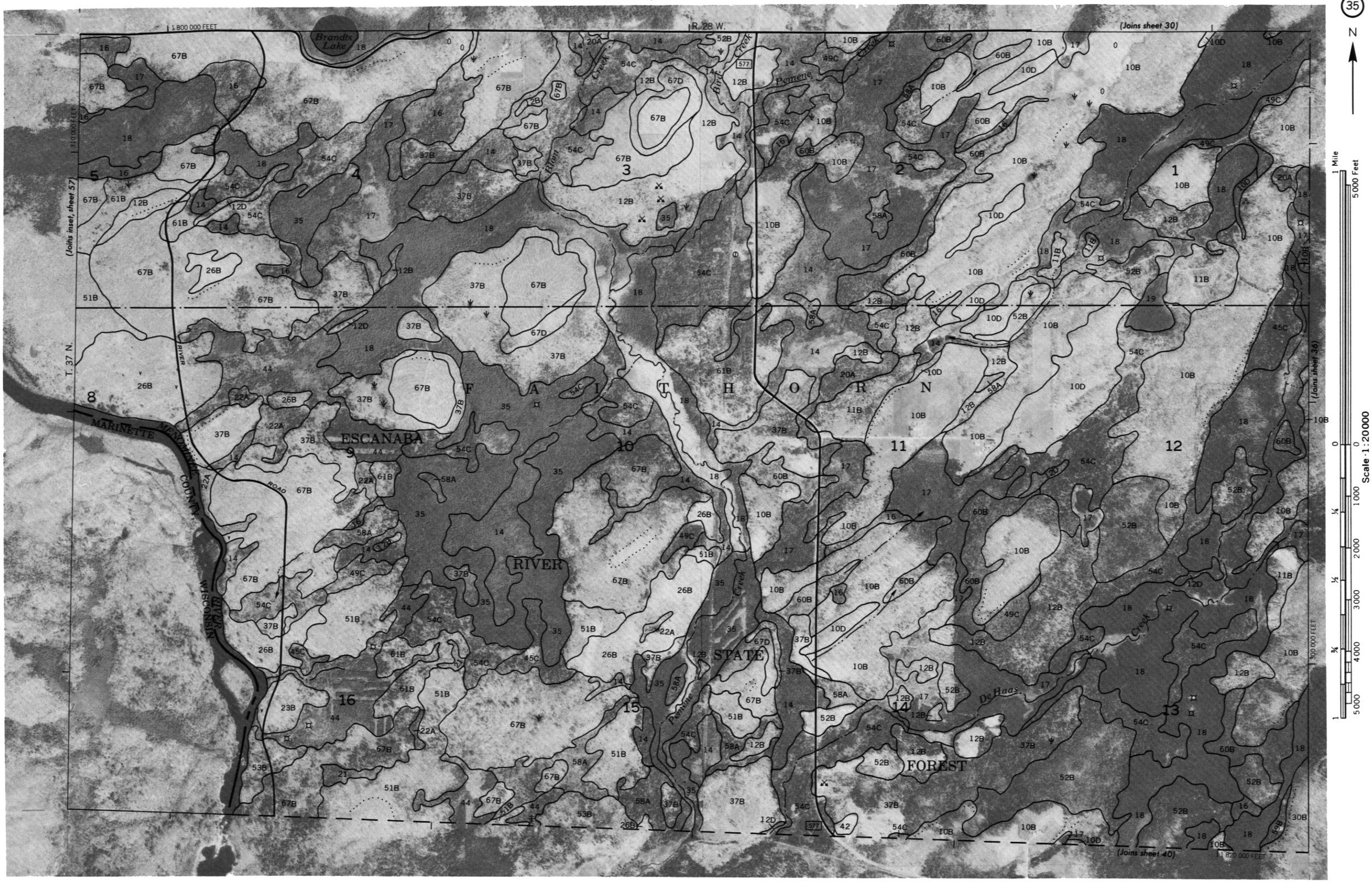


MENOMINEE COUNTY, MICHIGAN NO. 33

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

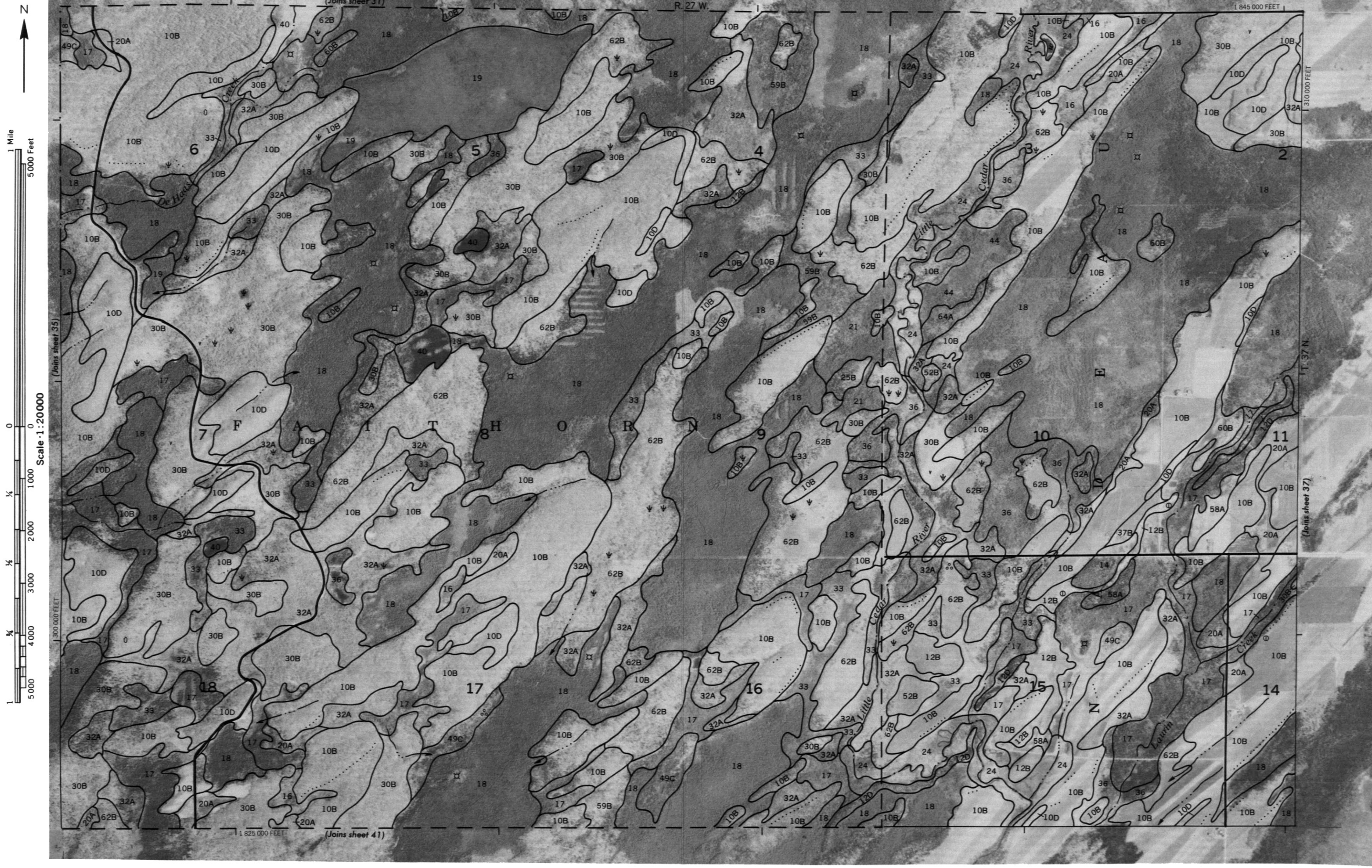


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

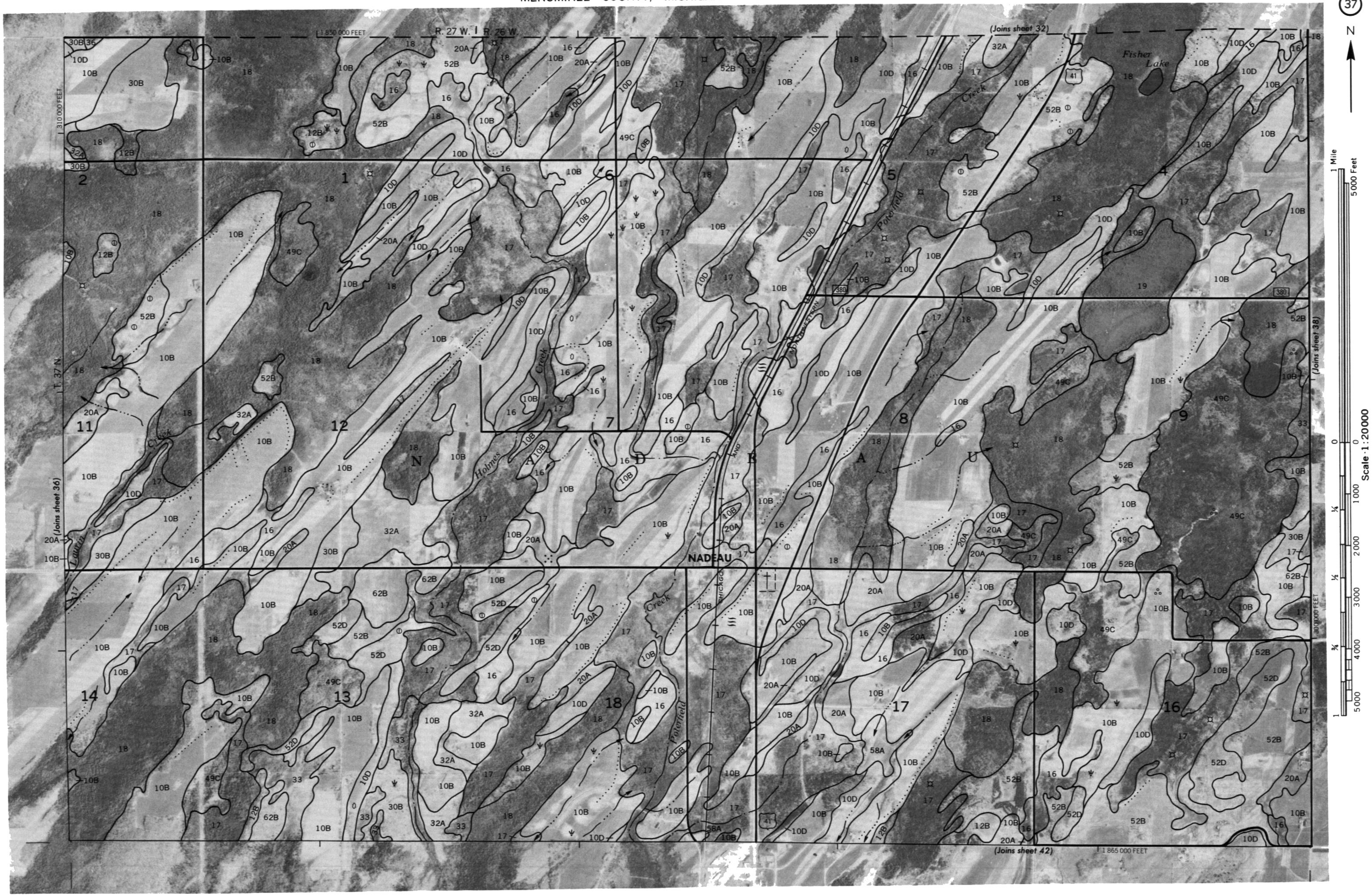


MENOMINEE COUNTY, MICHIGAN NO. 35

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

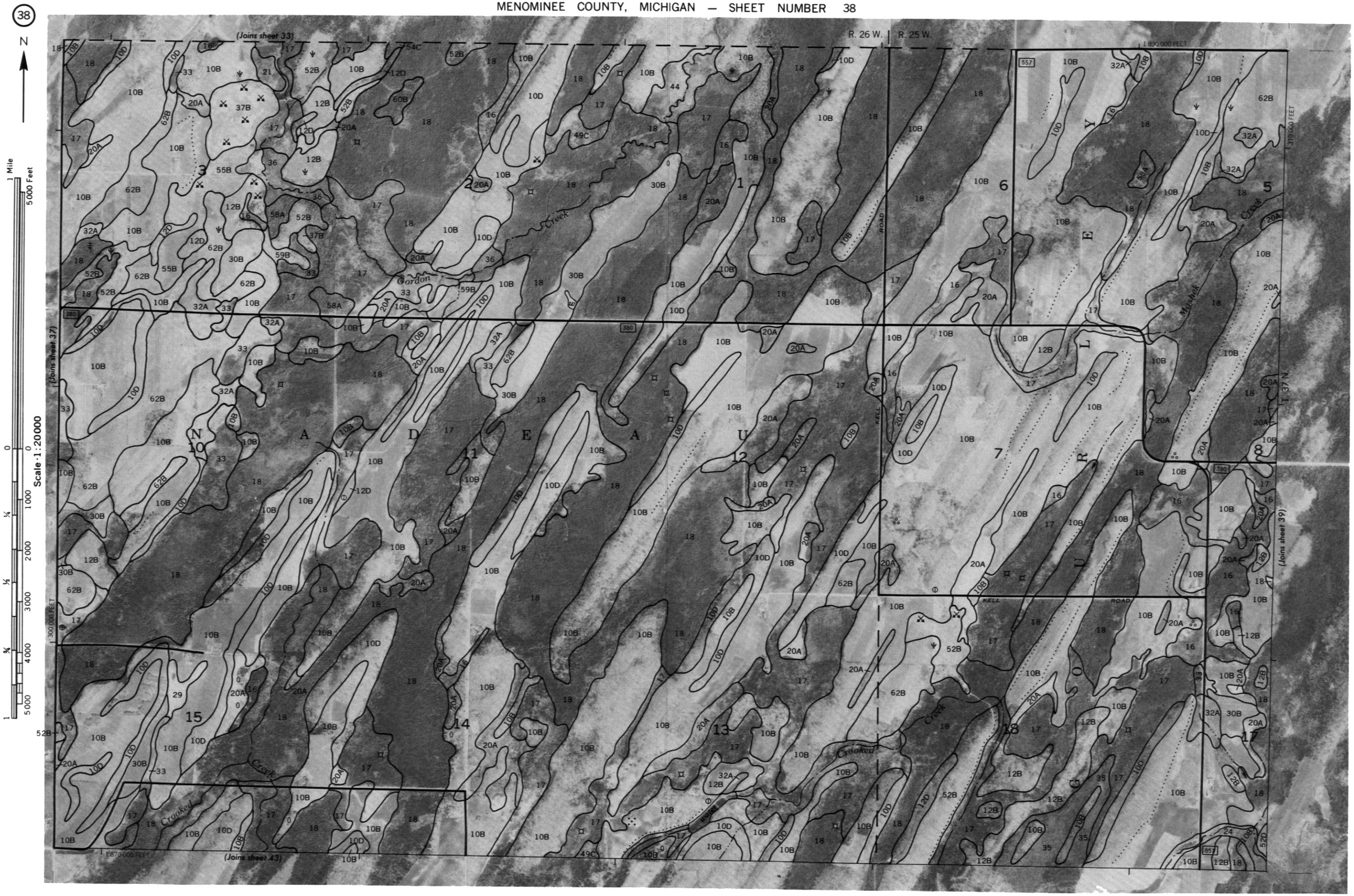


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



MENOMINEE COUNTY, MICHIGAN NO. 37

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 38

MENOMINEE COUNTY, MICHIGAN NO. 39

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(Joins sheet 34)
(Joins sheet 38)
(Joins sheet 44)

1 895 000 FEET
310 000 FEET
1 915 000 FEET
300 000 FEET

T. 37 N.
R. 25 W.

HANNAHVILLE ROAD

ESCANABA RIVER

BIG CEDAR RIVER

DELTA COUNTY

STATE FOREST

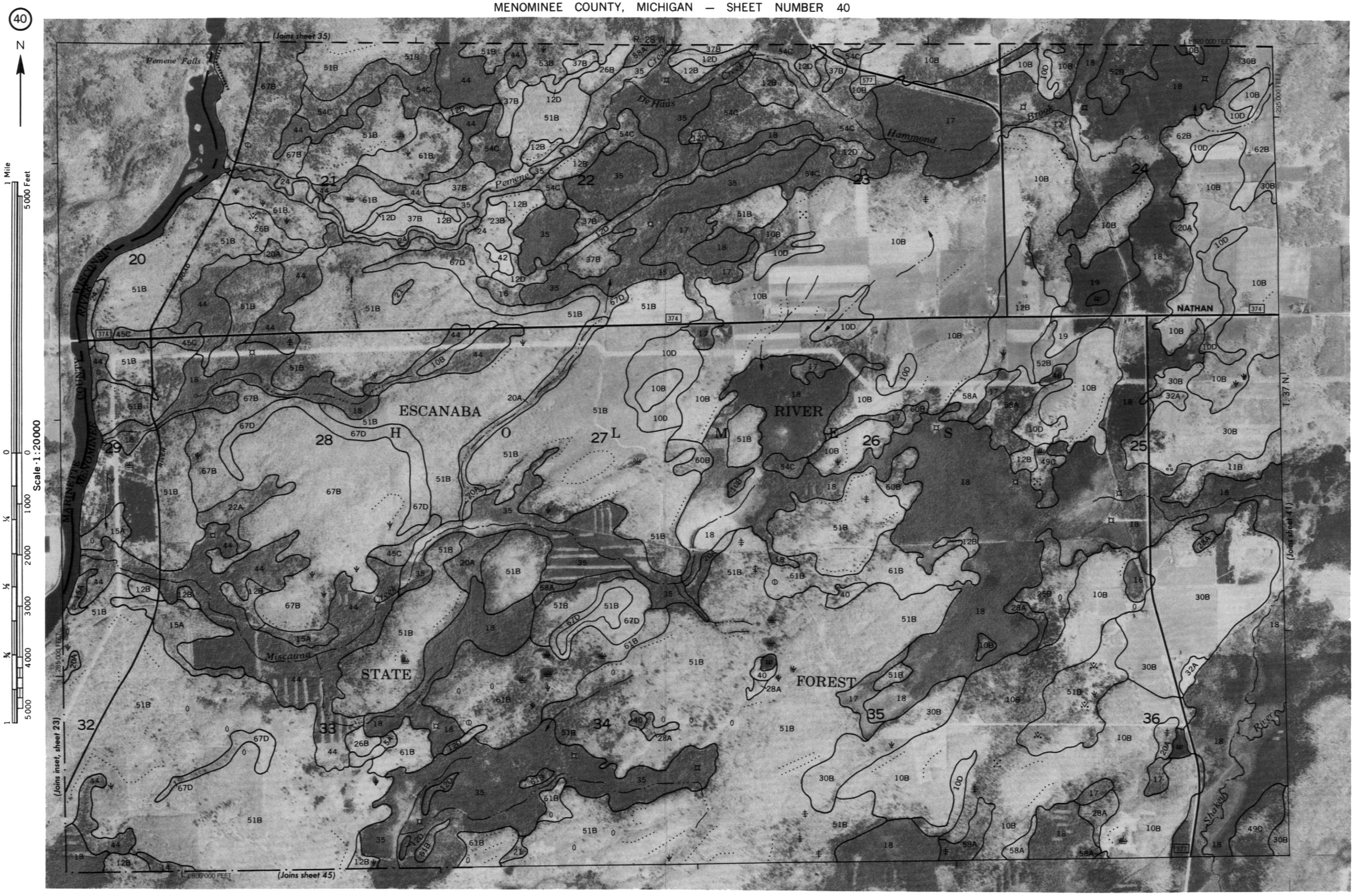
Mashek Creek
Crooked Creek
Tamarack Creek
Degraves Creek

39

N

1 Mile
5 000 Feet

Scale 1:20000

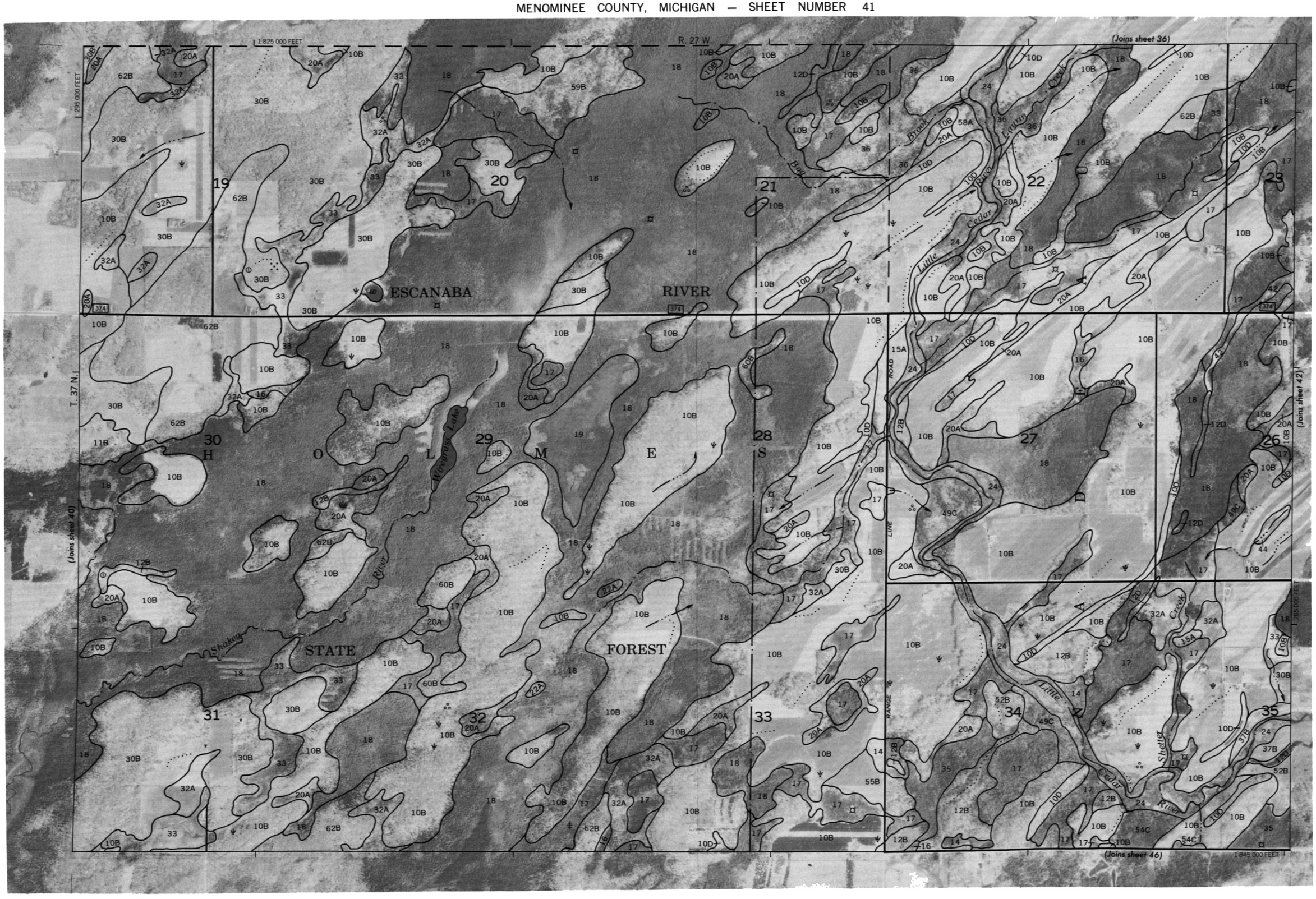


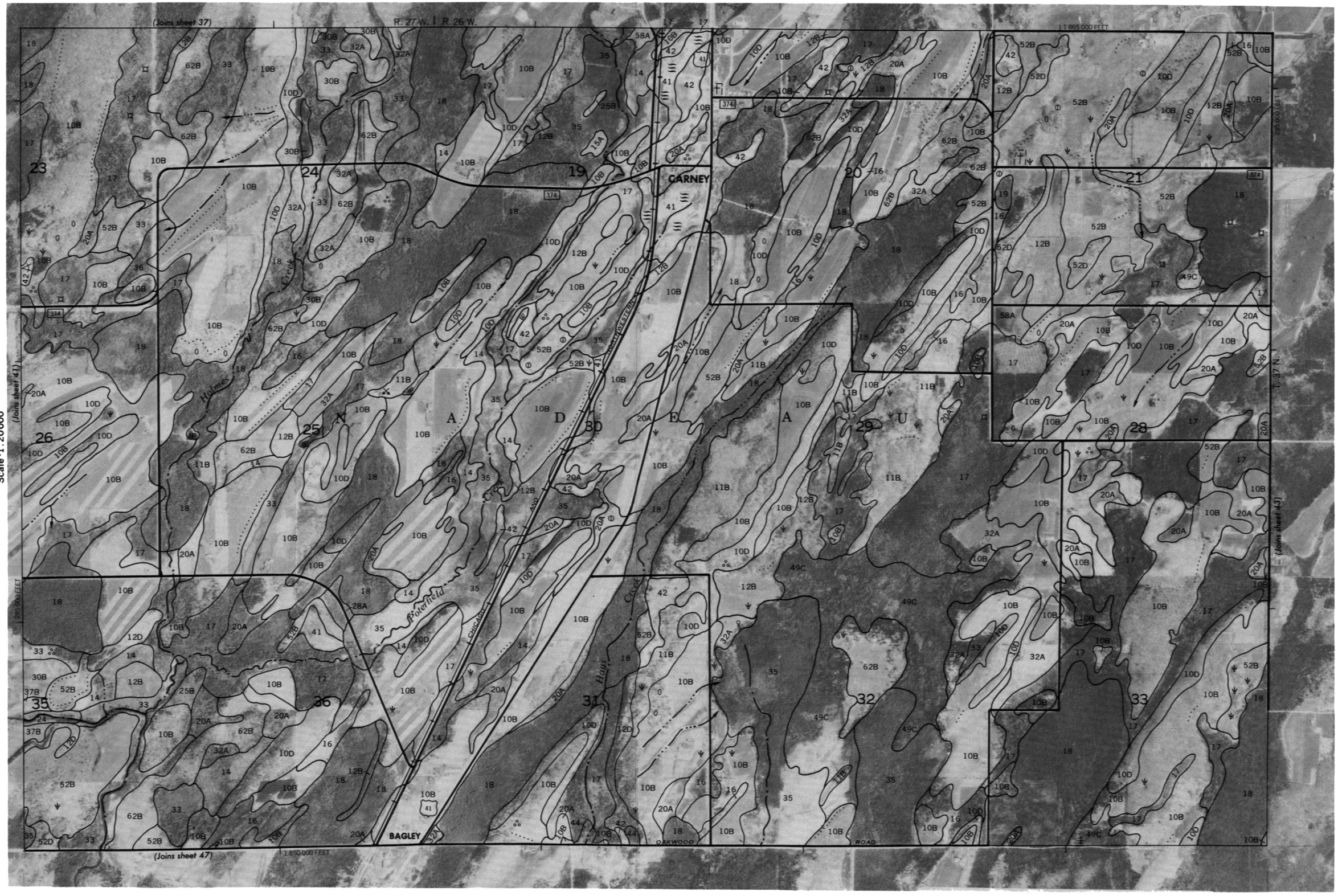
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 40

MENOMINEE COUNTY, MICHIGAN NO. 41

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 42

MENOMINEE COUNTY, MICHIGAN NO. 43

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 870 000 FEET

295 000 FEET

R. 26 W.

R. 25 W.

(Joins sheet 38)

T. 37 N.

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 48)

1 890 000 FEET

280 000 FEET

Crooked Creek

Camp Creek

Devils Creek

43

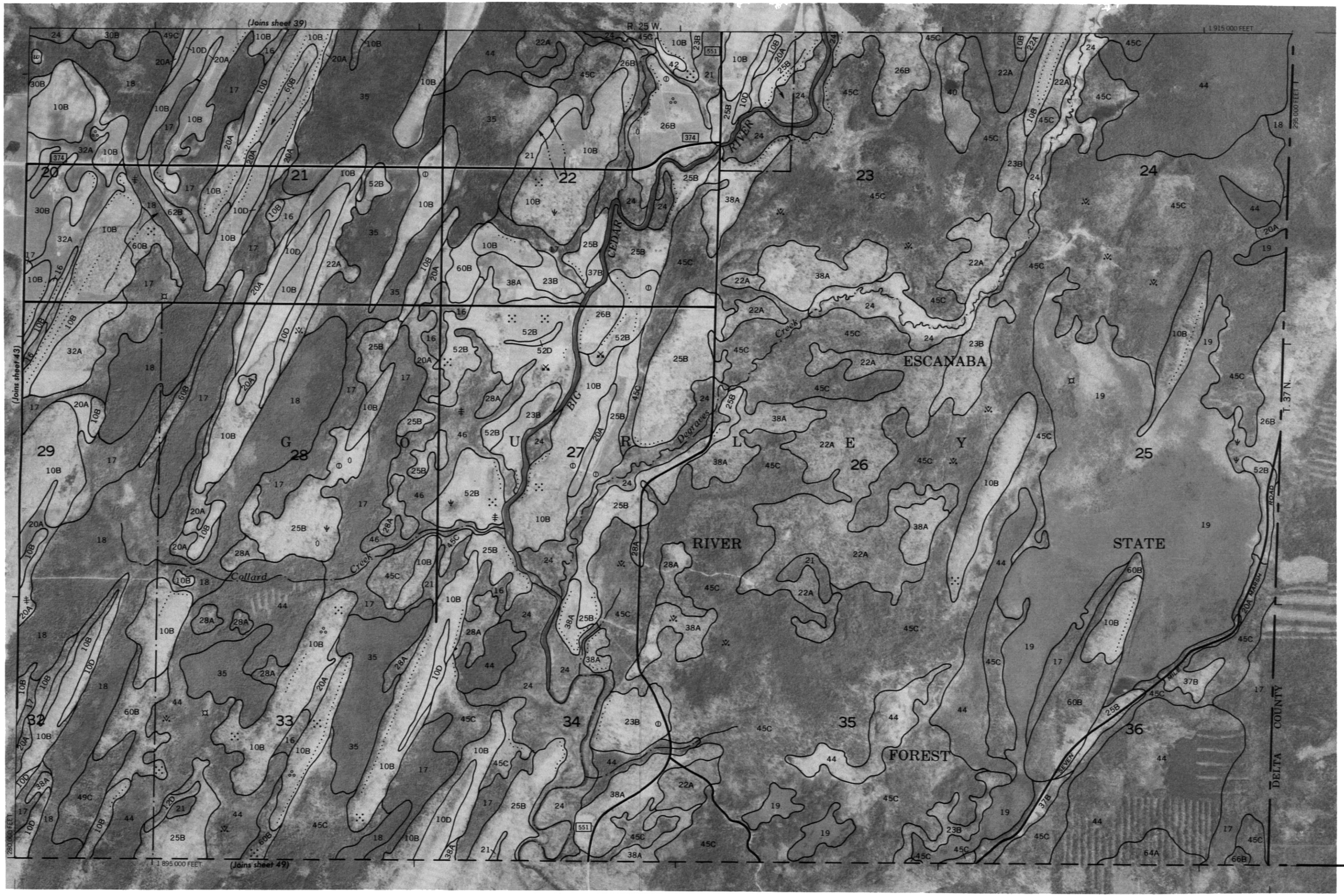
N

1 Mile

5000 Feet

0

Scale 1:20000



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 44

N

MENOMINEE COUNTY, MICHIGAN NO. 45

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 800 000 FEET

280 000 FEET

R. 28 W.

(Joins sheet 40)

(Joins sheet 29)

(Joins sheet 46)

(Joins sheet 51)

1 820 000 FEET

265 000 FEET

T. 36 N.

ESCANABA

RIVER

STATE

FOREST

HILLS

ROAD

BANAT

Goodman Brook

Dawn Lake

Sunset Lake

Saubridge Creek

Rosebush Creek

Shakey River

Little Creek

1 Mile

5000 Feet

Scale · 1:20000

N

Scale 1:20000

1 Mile 5000 Feet

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

1¼ 5000

R. 27 W.

T. 36 N.

(Joins sheet 41)

(Joins sheet 45)

(Joins sheet 47)

(Joins sheet 52)

1 845 000 FEET

280 000 FEET

265 000 FEET

1 825 000 FEET

Creek

Little

Stuckey

Ross

Cedar

River

ROAD

HILLS

CHALK

BANAT

ESCANABA

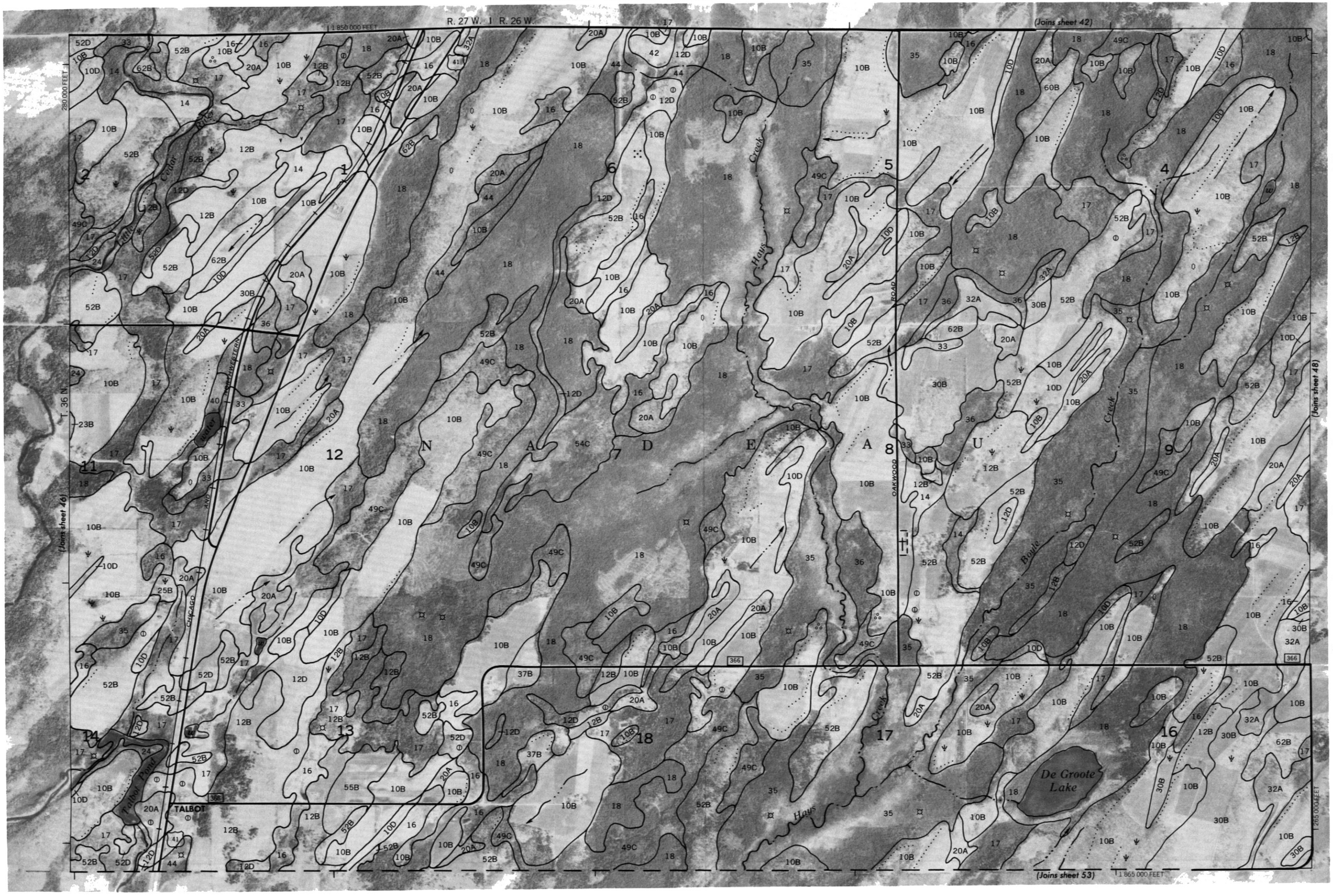
STATE

FOREST

577

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 46



MENOMINEE COUNTY, MICHIGAN NO. 47

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

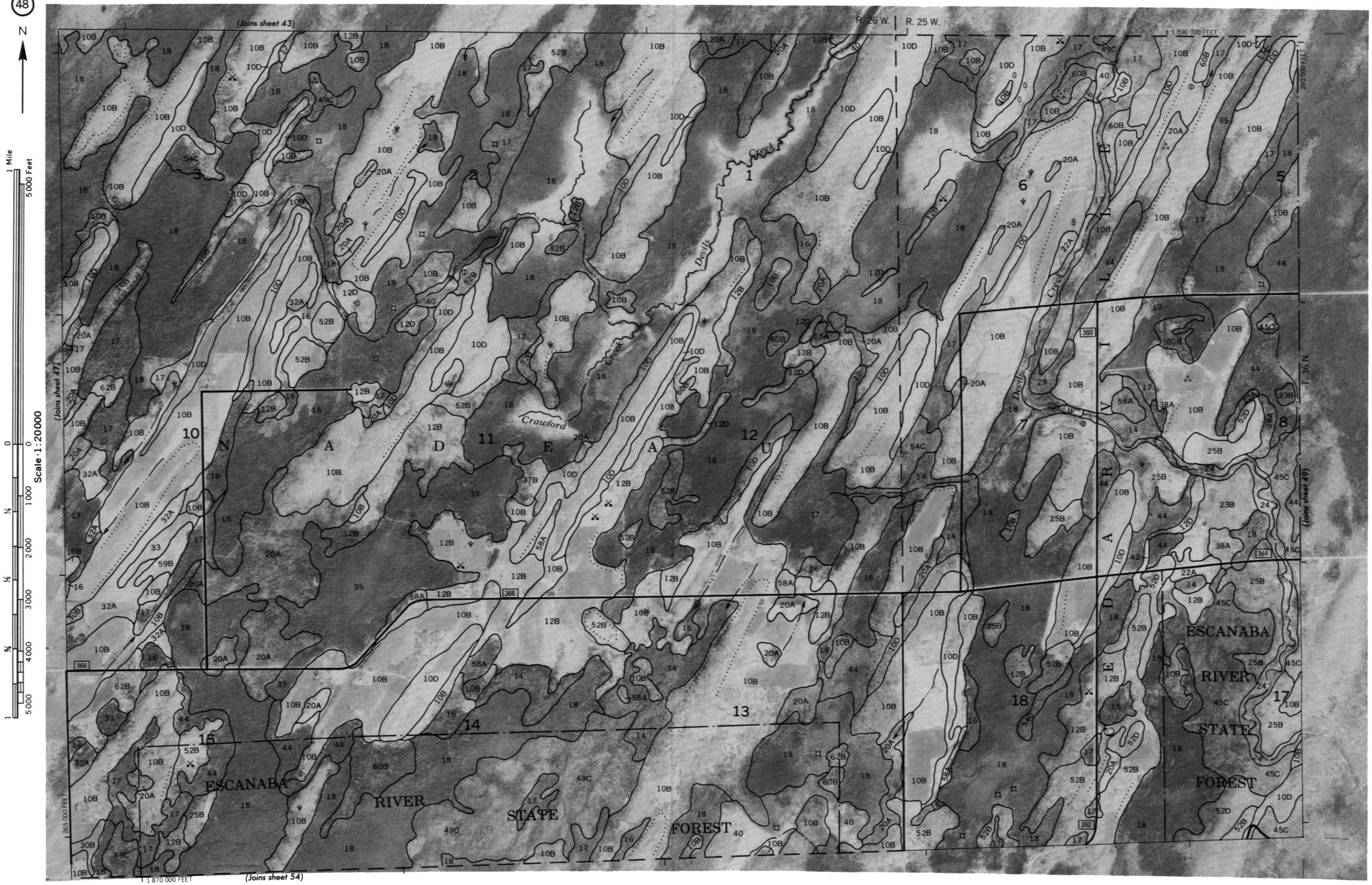
47

N

1 Mile
5000 Feet

Scale 1:20000

MENOMINEE COUNTY, MICHIGAN — SHEET NUMBER 48



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 48

MENOMINEE COUNTY, MICHIGAN NO. 49

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

50

N

1 Mile

5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

DELTA COUNTY

R. 24 W.

1 930 000 FEET

275 000 FEET

265 000 FEET

1 920 000 FEET

T. 36 N.

(Joins sheet 49)

(Joins sheet 56)

(Joins inset, sheet 29)

(Joins sheet 51)

(Joins sheet 57)

1 790 000 FEET

ESCANABA RIVER

CEDAR ISLE

GREEN BAY

STATE FOREST

Deer Creek

Olson Creek

Fox Creek

North Deer Creek

Fox Road

Wisconsin River

Menominee County

Merryman Island

Marinette Menominee

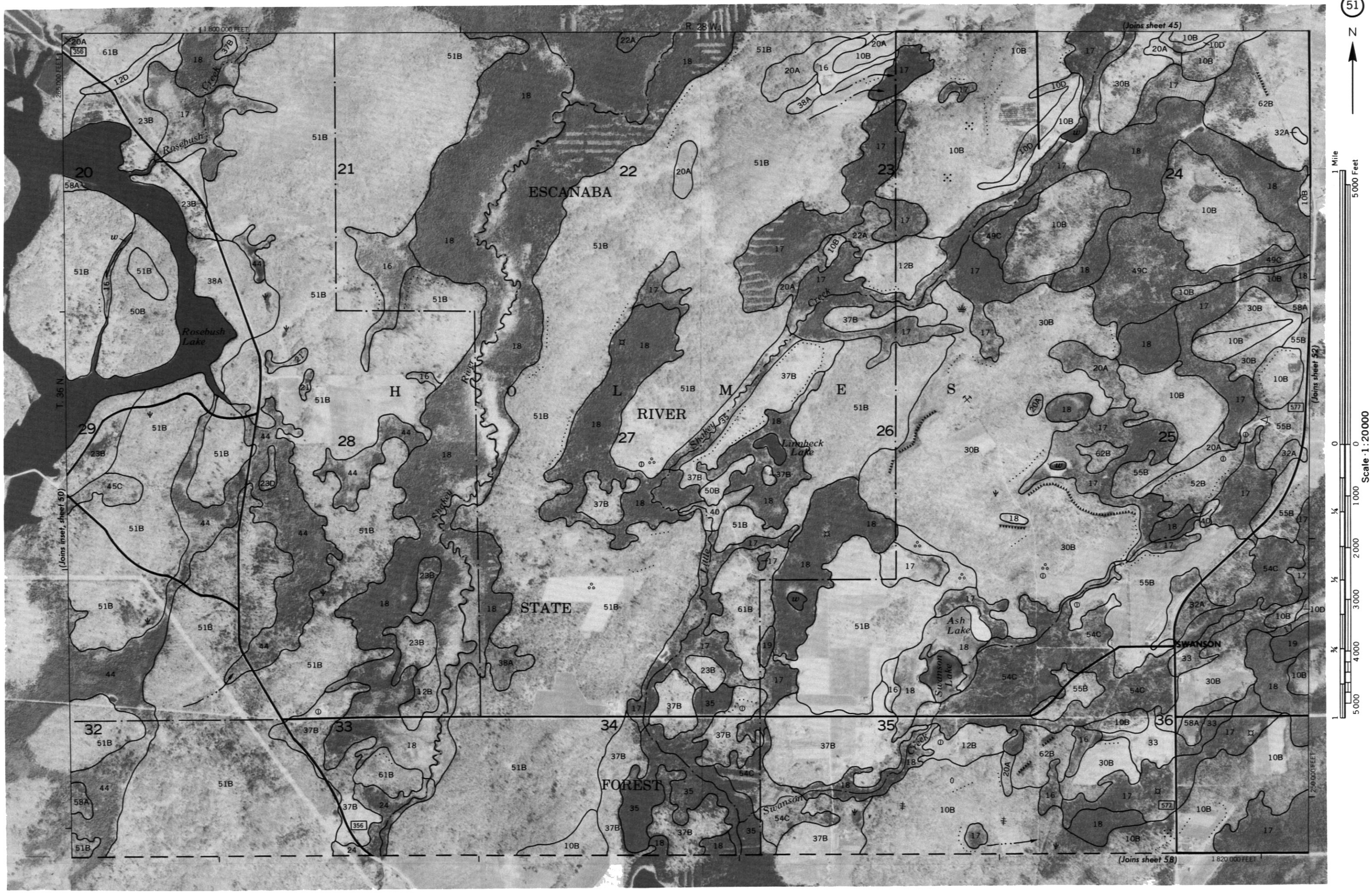
White Rapids Dam

Rosebush Lake

2000 AND 6000 FOOT GRID TICKS

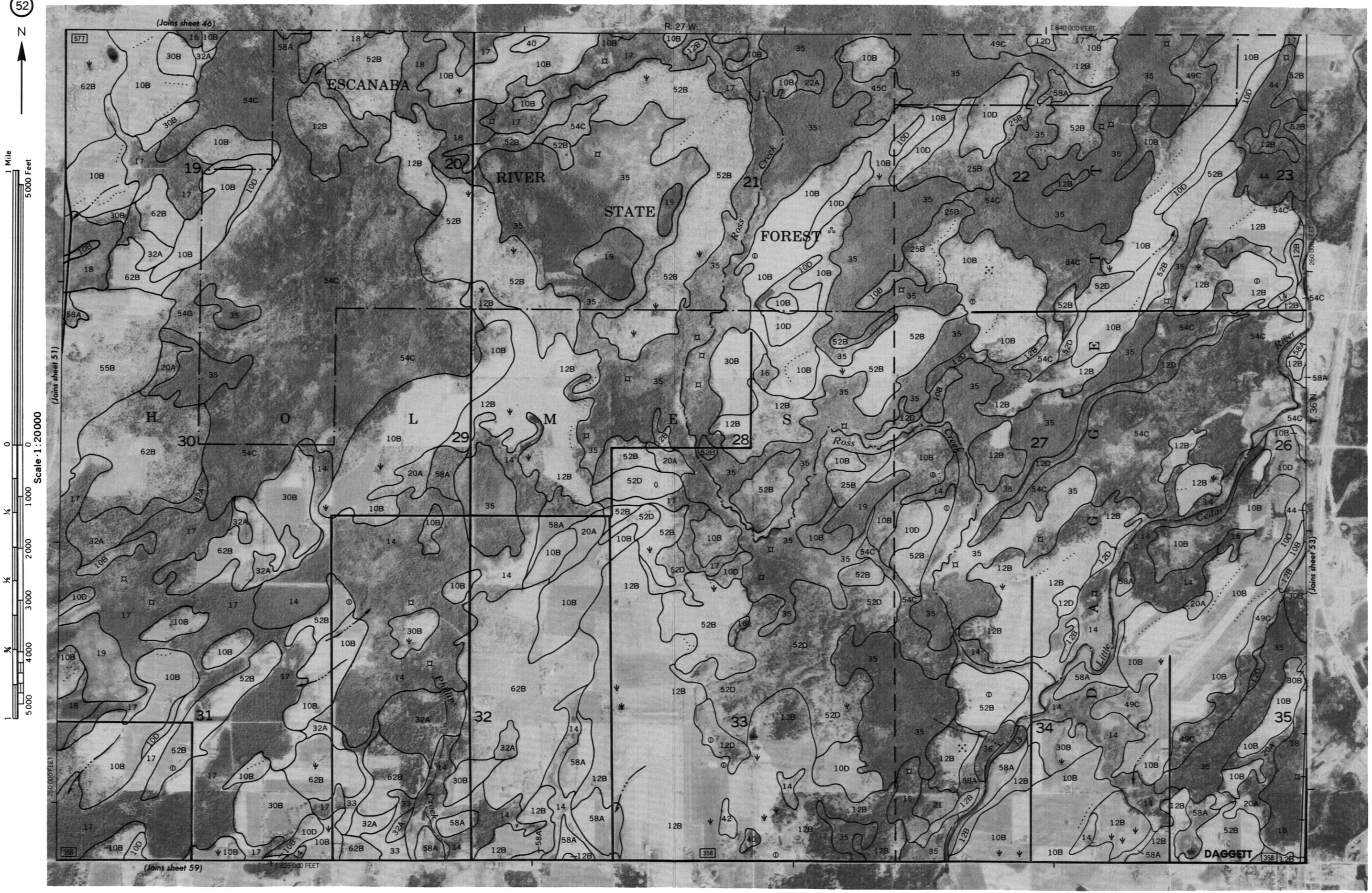
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 50



MENOMINEE COUNTY, MICHIGAN NO. 51

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 52

MENOMINEE COUNTY, MICHIGAN NO. 53

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(Joins sheet 47)
(Joins sheet 54)
(Joins sheet 52)
(Joins sheet 60)

R. 27 W. R. 26 W.

T. 36 N.

1 845 000 FEET
1 860 000 FEET
1 250 000 FEET
1 865 000 FEET

Little Cedar River
Cedar Creek
Haus Creek
Haus Creek
CHICAGO NORTHWESTERN
CHICAGO NORTHWESTERN
REVELL ROAD

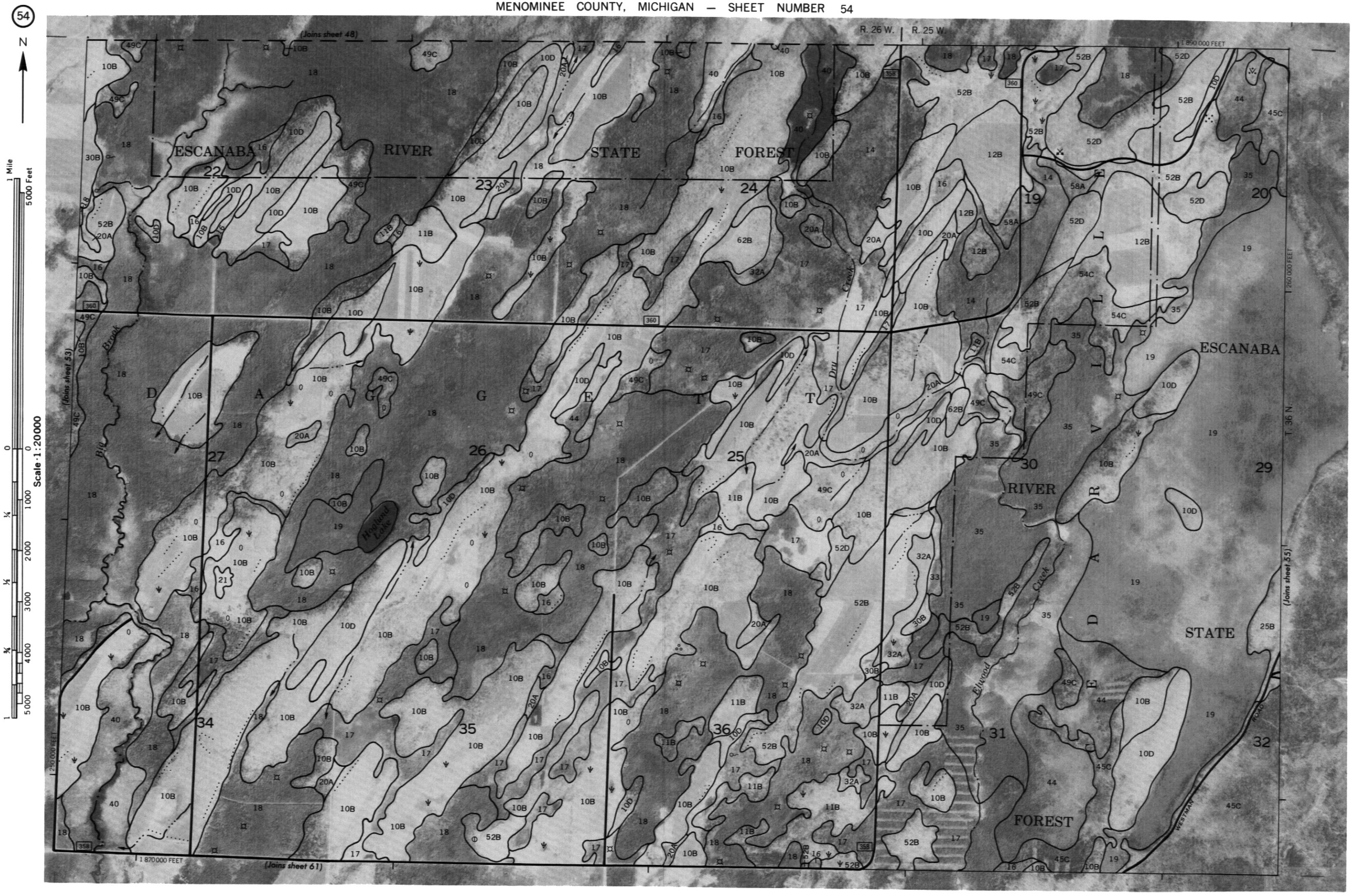
19 20 21 24 25 26 28 29 30 31 32 33 35 36

53

N

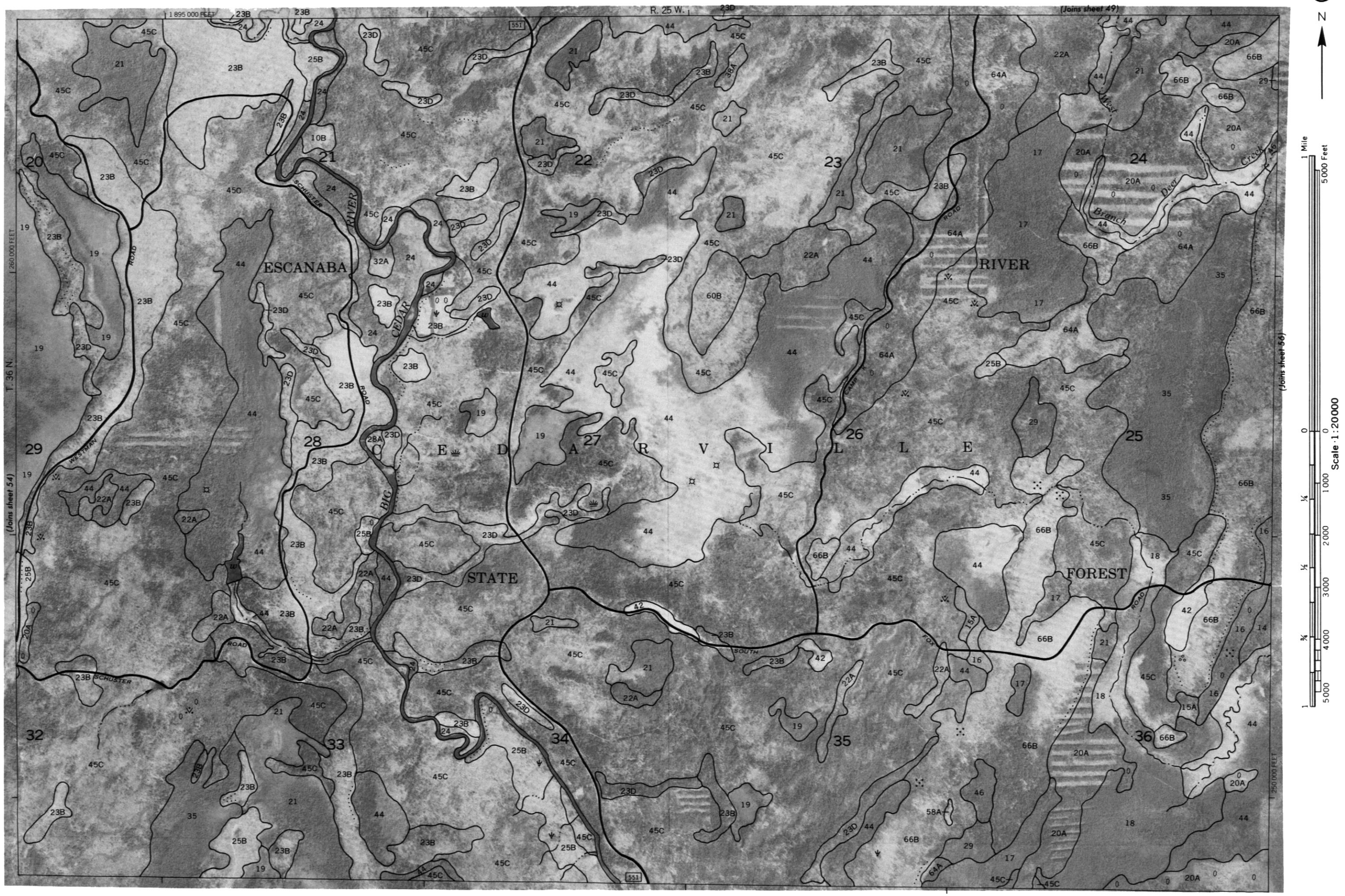
1 Mile
5000 Feet

Scale 1:20000



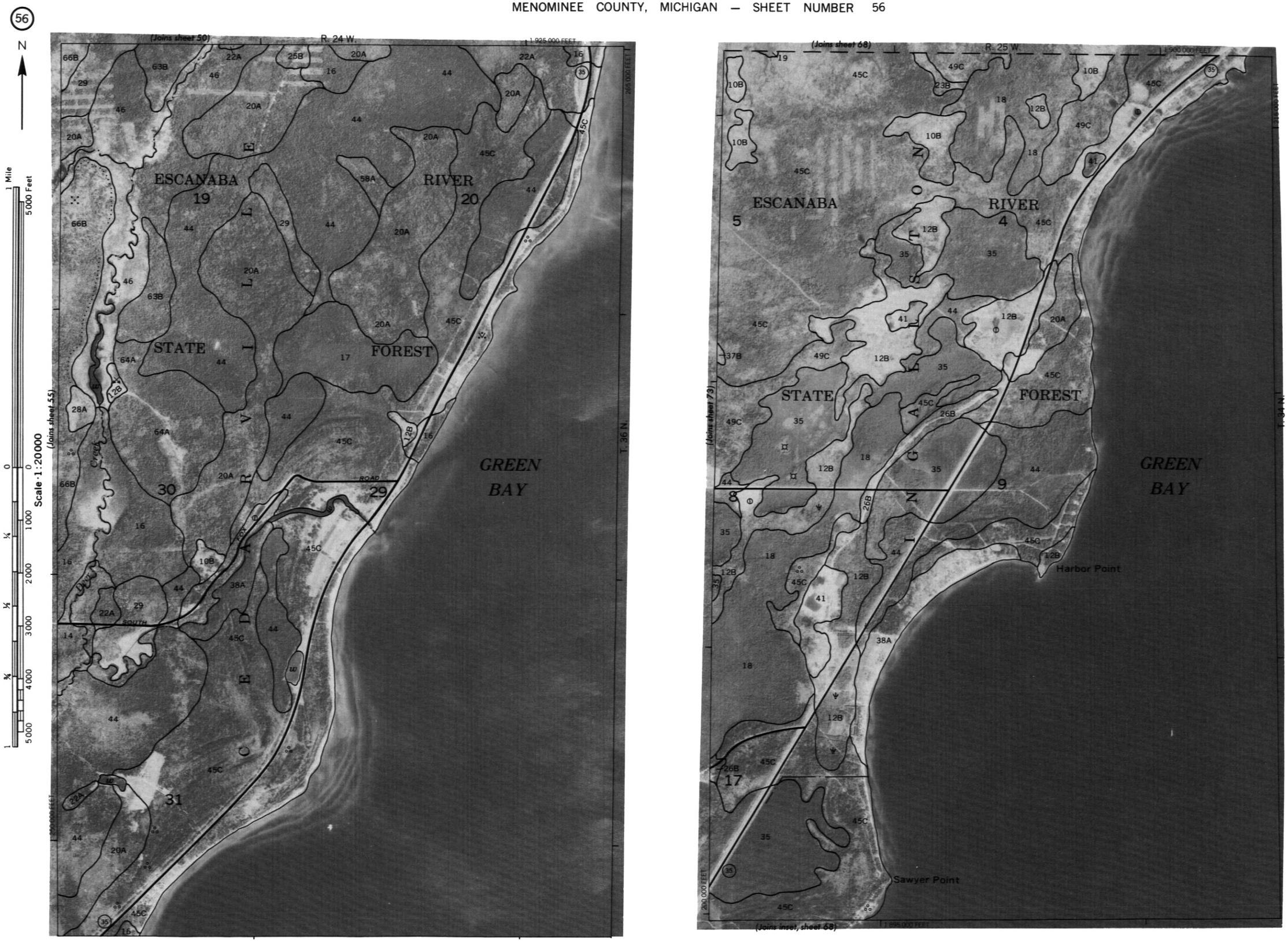
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 54



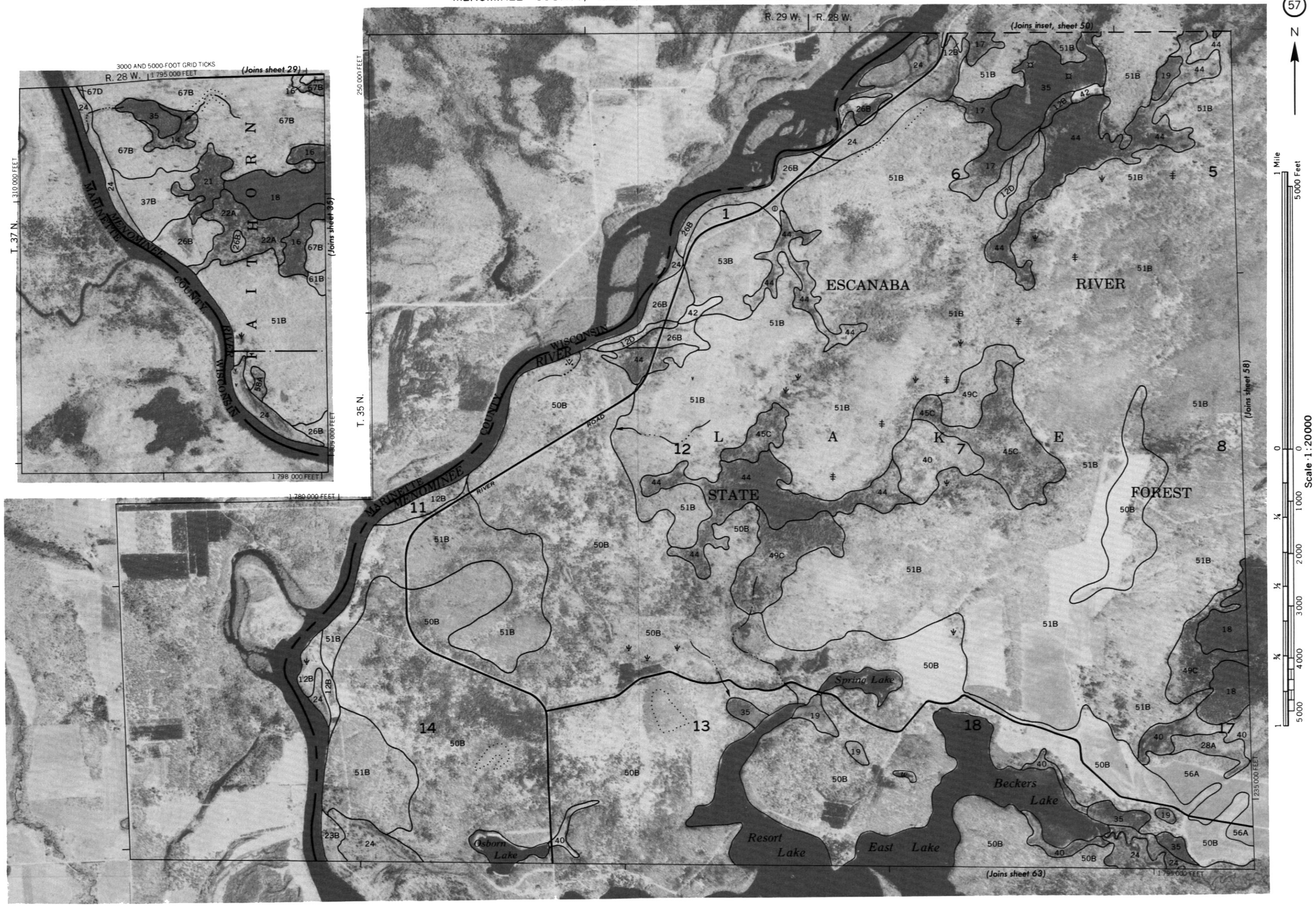
MENOMINEE COUNTY, MICHIGAN NO. 55

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 56



MENOMINEE COUNTY, MICHIGAN NO. 57

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

58

N

1 Mile
5000 Feet

Scale 1:20000

(Joins sheet 51)

(Joins sheet 57)

1 820 000 FEET

1 800 000 FEET

(Joins sheet 64)

1 845 000 FEET

(Joins sheet 59)

R. 28 W.

T. 35 N.

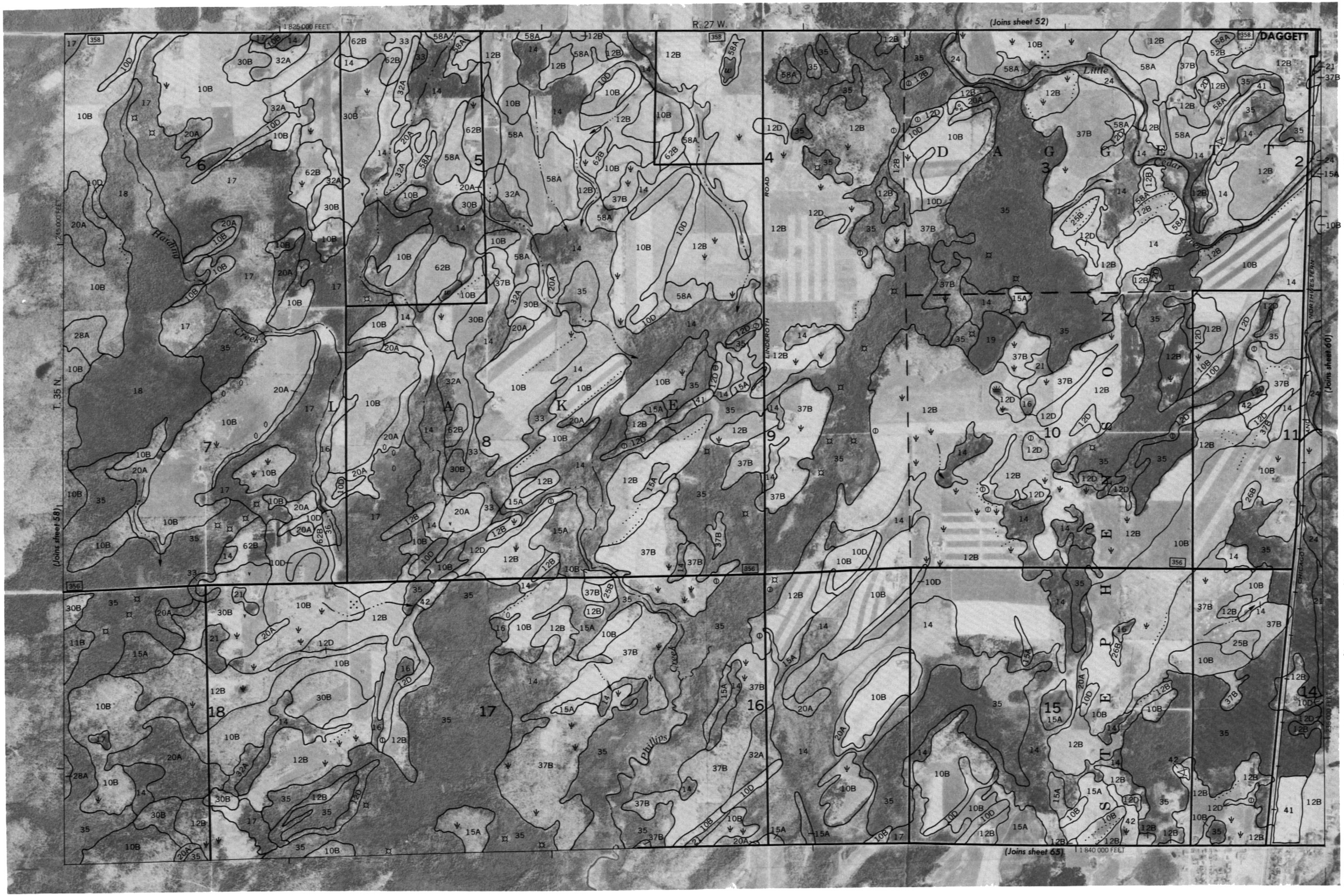
ESCANABA RIVER STATE FOREST

Shakey River
Little Shakey Creek
Johnson Lake
Lake Ann
Lake Mary
Duck Lake
Johnsons Lake
Longrie Creek

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 58

59



N

1 Mile

5000 Feet

Scale 1:20000

MENOMINEE COUNTY, MICHIGAN NO. 59

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

60

N

Scale 1:20000

1 Mile 5000 Feet

0 0 ¼ ½ ¾ 1

1000 2000 3000 4000 5000

(Joins sheet 53)

R. 27 W. R. 26 W.

1 865 000 FEET

1 845 000 FEET

T. 35 N.

(Joins sheet 59)

(Joins sheet 66)

(Joins sheet 61)

Wagner Lake

Brook

Creek

River

Little

Brook water

Drain

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 60

MENOMINEE COUNTY, MICHIGAN NO. 61

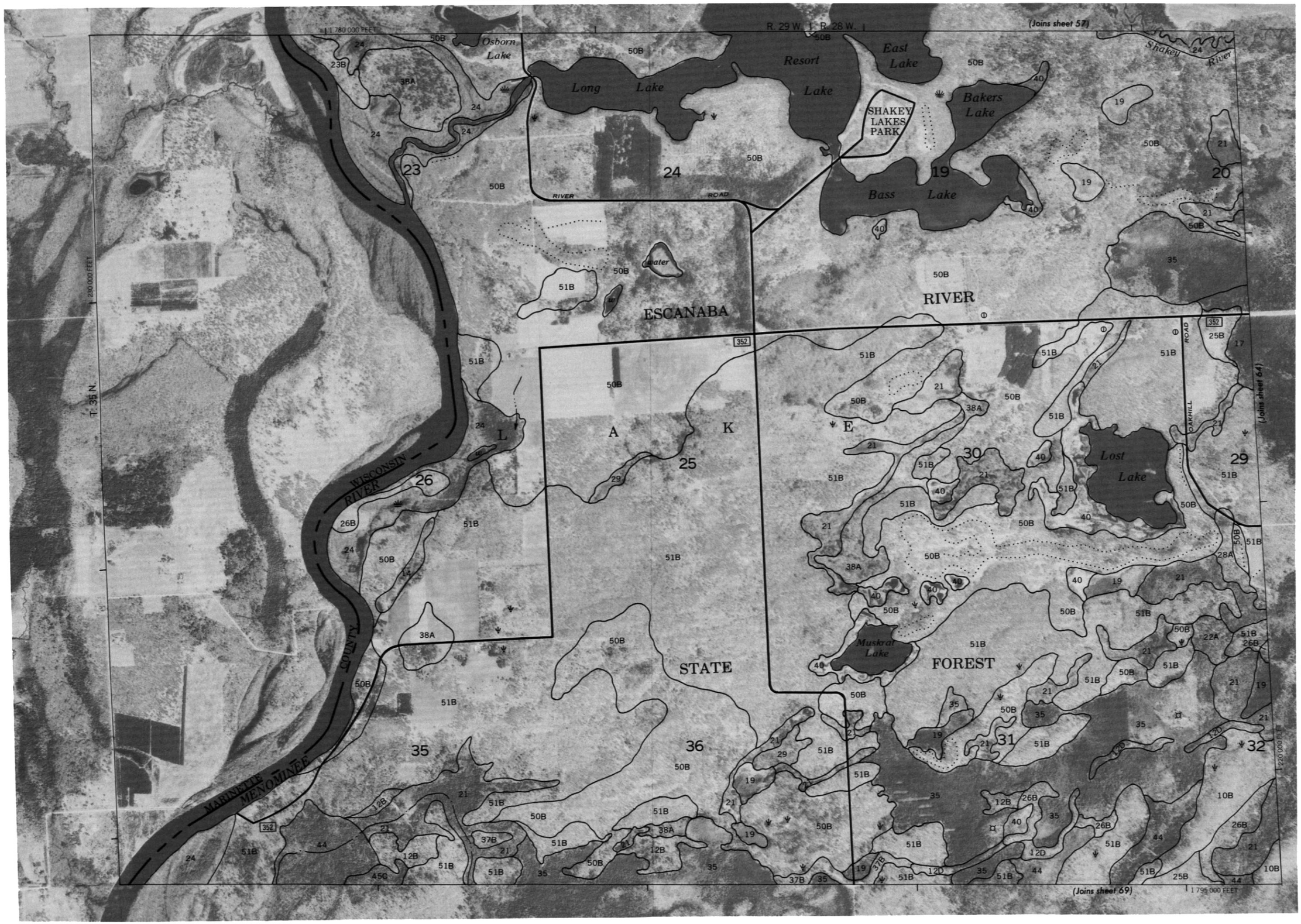
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 62

MENOMINEE COUNTY, MICHIGAN NO. 63

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



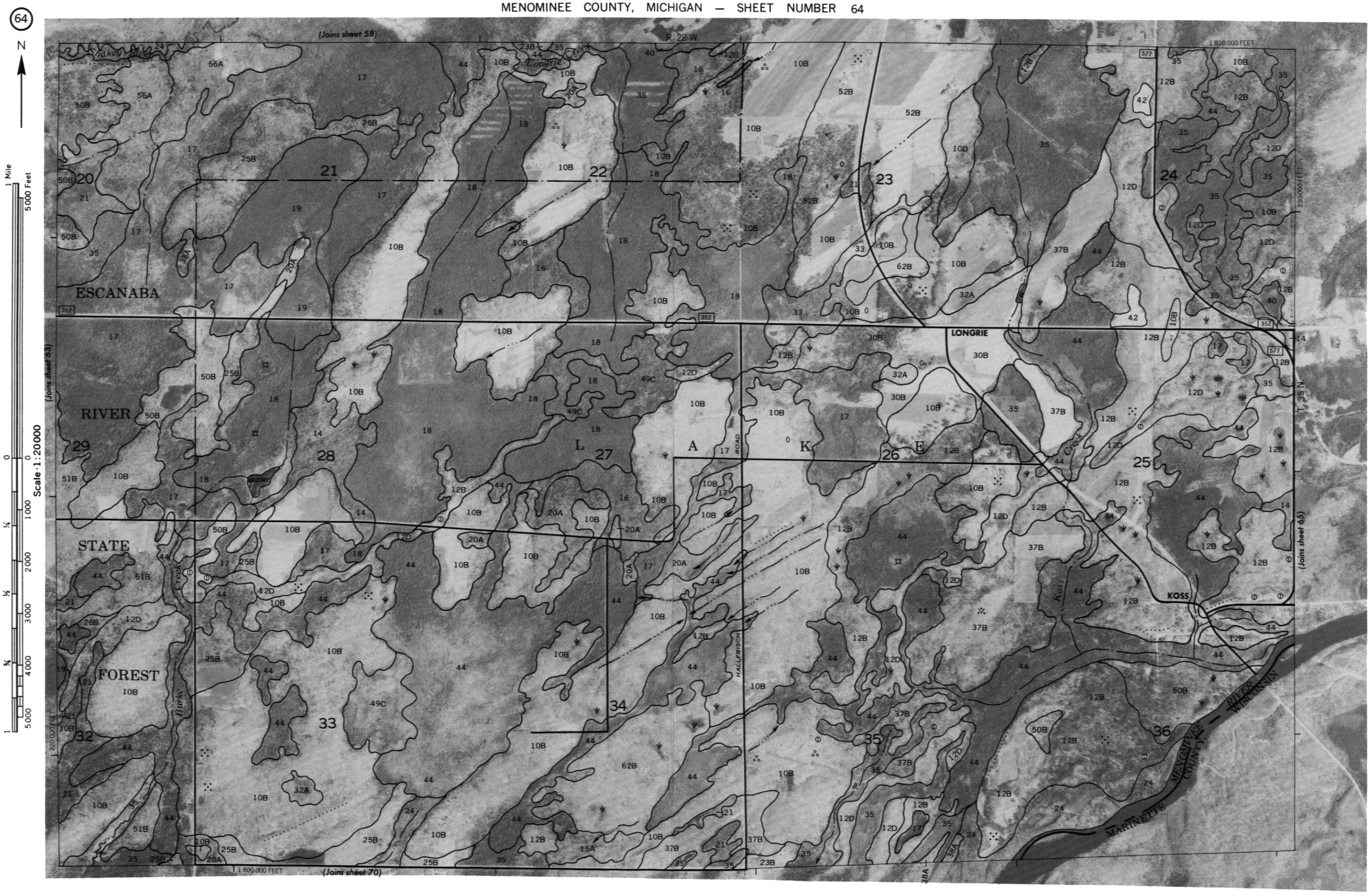
63

N

1 Mile

5000 Feet

Scale · 1:20000



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 64

MENOMINEE COUNTY, MICHIGAN NO. 65

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 66

MENOMINEE COUNTY, MICHIGAN NO. 67

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

67

N

1 870 000 FEET

290 000 FEET

R. 26 W. | R. 25 W.

(Joins sheet 61)

T. 35 N.

(Joins sheet 66)

(Joins sheet 68)

(Joins sheet 73)

1 890 000 FEET

1 850 000 FEET

Walton River

North Lake

Little Lake

Big Brook

ESCANABA RIVER

WESTMAN ROAD

TOWNLINE ROAD

STATE FOREST

S T E P H E N S O N

1 Mile

5000 Feet

Scale 1:20000

68

N

Scale 1:20000

1 Mile 5000 Feet

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

(Joins sheet 67)

(Joins sheet 67)

(Joins inset, sheet 56)

R. 25 W.

T. 35 N.

1 315 000 FEET

1 290 000 FEET

1 895 000 FEET

CEDAR RIVER

Walton River

GREEN BAY

JW WELLS STATE PARK

CEDAR RIVER

Cemetery Road

352

35

20 21 22 23 24 26 27 28 29 32 33 34

C E D A R R I V E R

L 27 L E

(Joins inset, sheet 56)

R. 25 W.

1 895 000 FEET

(Joins sheet 76)

1 892 000 FEET

T. 34 N.

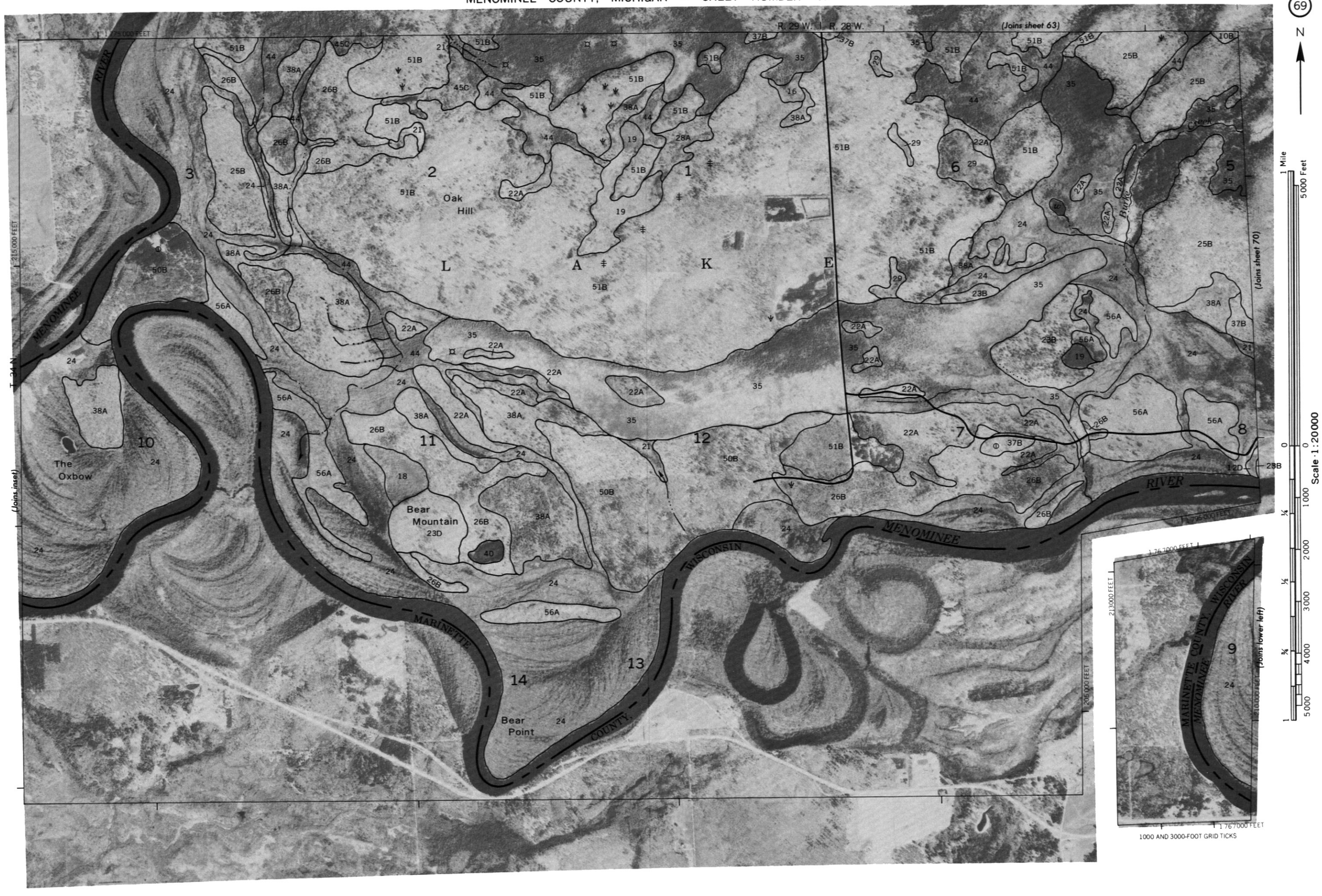
1 892 000 FEET

GREEN BAY

2000 AND 3000-FOOT GRID TICKS

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 68



MENOMINEE COUNTY, MICHIGAN NO. 69

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

70

N

1 Mile

5 000 Feet

Scale 1:20000

(Joins sheet 64)

(Joins sheet 69)

R. 28 W.

1 815 000 FEET

1 800 000 FEET

205 000 FEET

175 000 FEET

T. 34 N.

T. 33 N.

(Joins sheet 77)

(Joins inset, sheet 82)

2000 AND 5000-FOOT GRID TICKS

MARINETTE COUNTY, WISCONSIN

MENOMINEE COUNTY, MICHIGAN

ESCANABA RIVER

MENOMINEE RIVER

Snakey Lake

Burke Creek

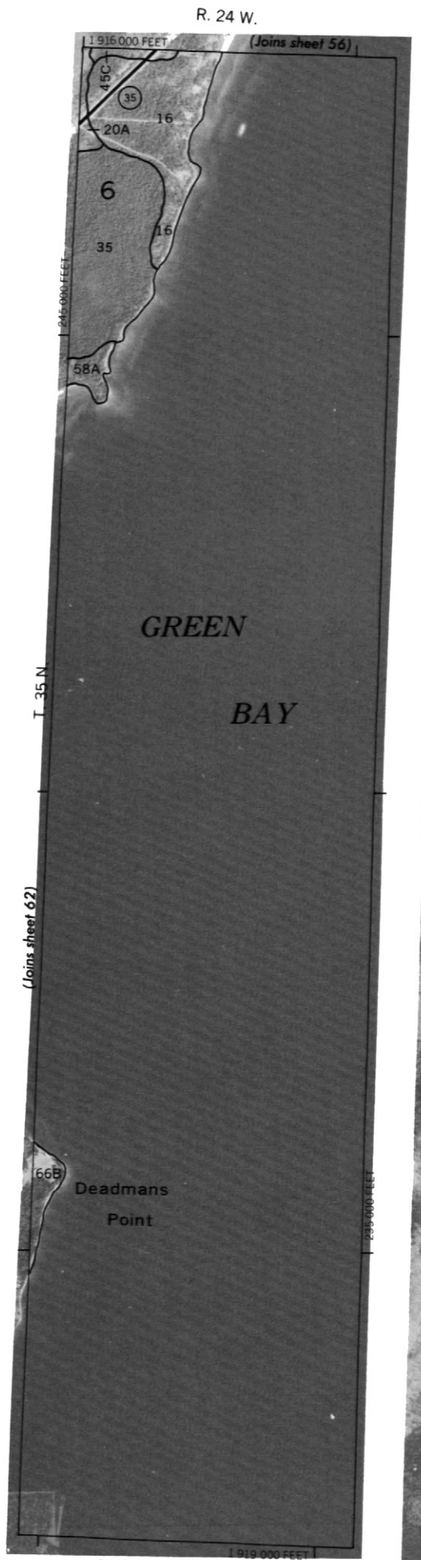
STATE FOREST

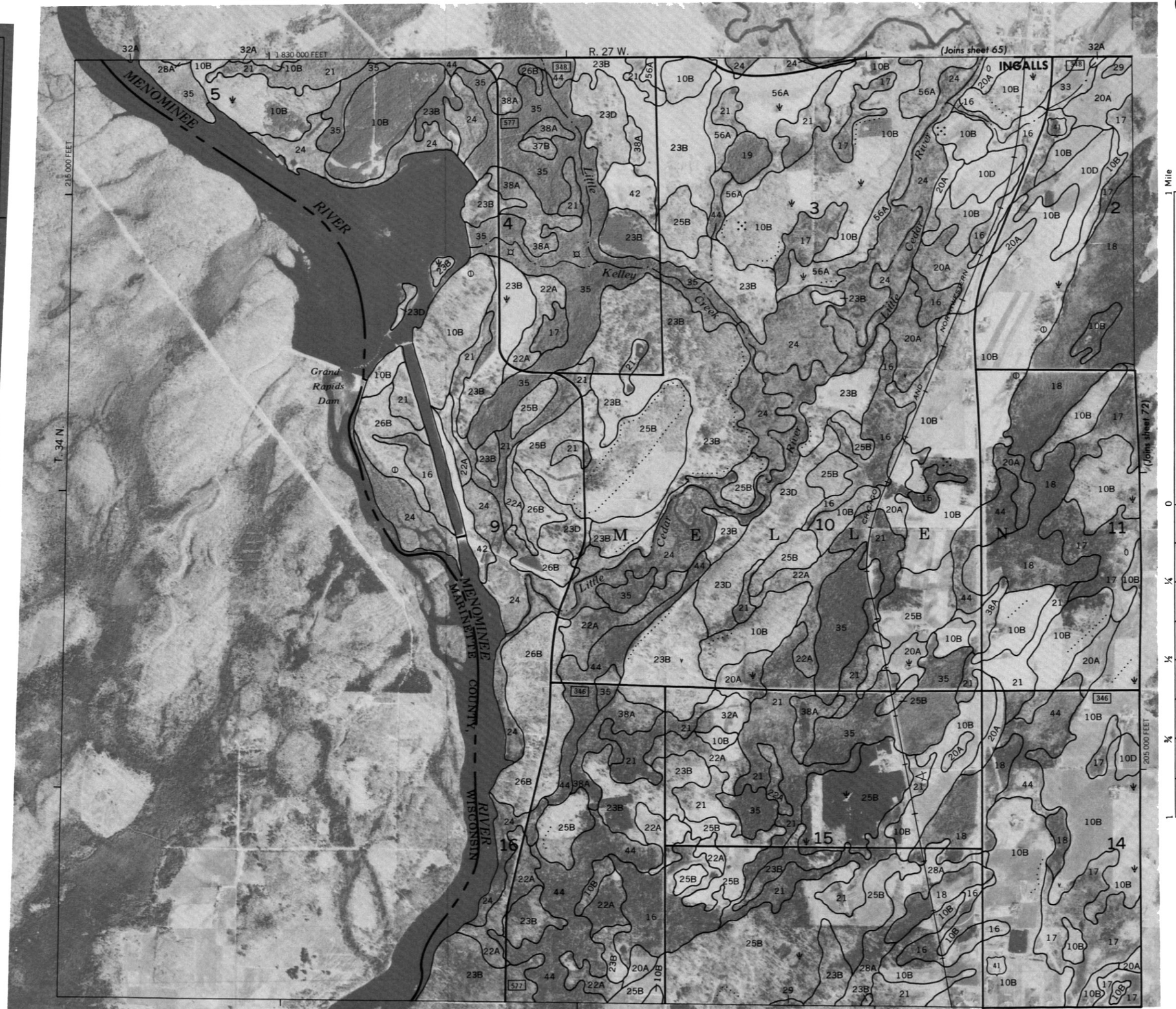
L A K E

M E N O M I N E E

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 70





71

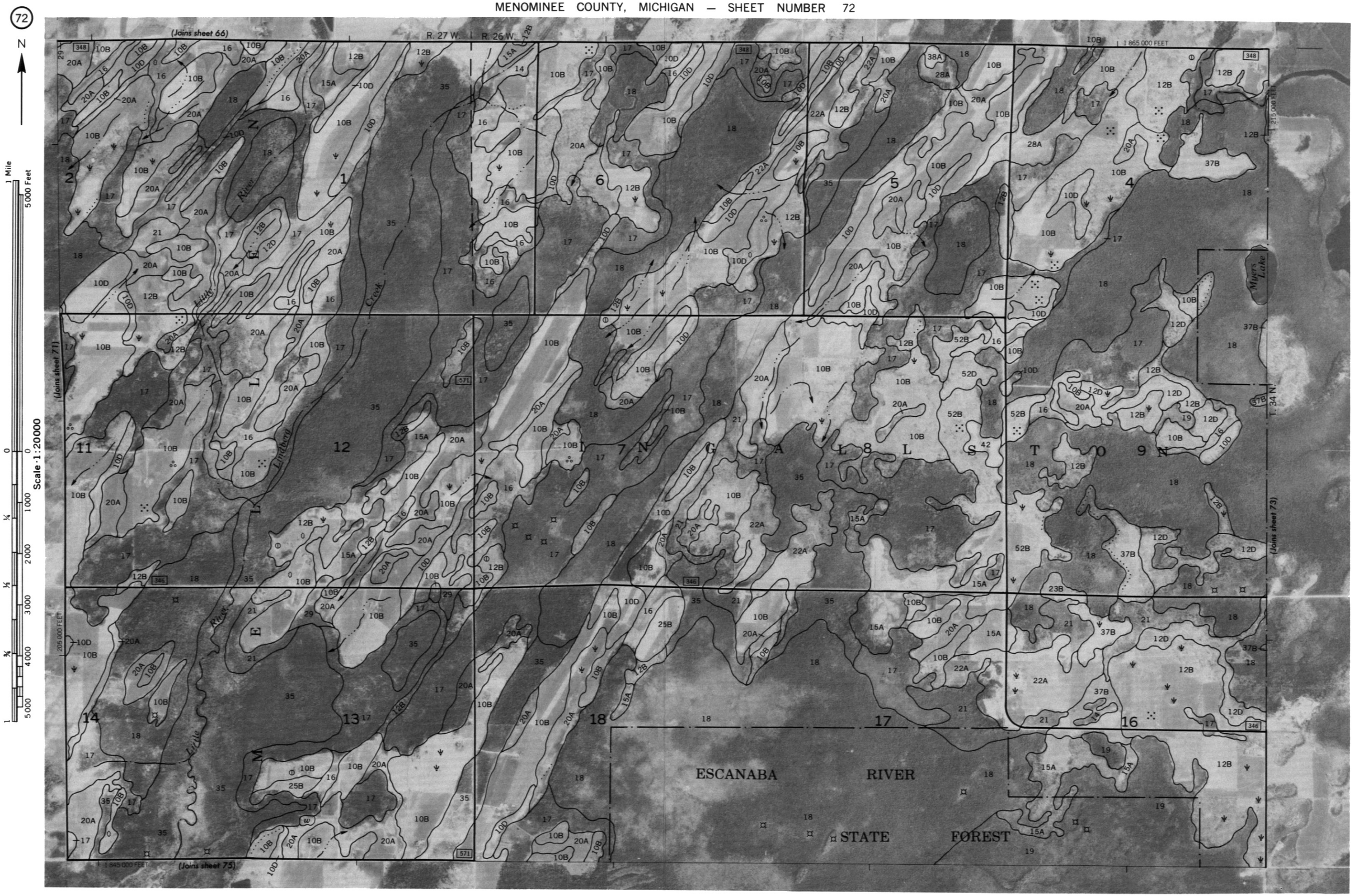
N

1 Mile
5000 Feet
Scale 1:20000

MENOMINEE COUNTY, MICHIGAN NO. 71

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

3000 AND 5000-FOOT GRID TICKS

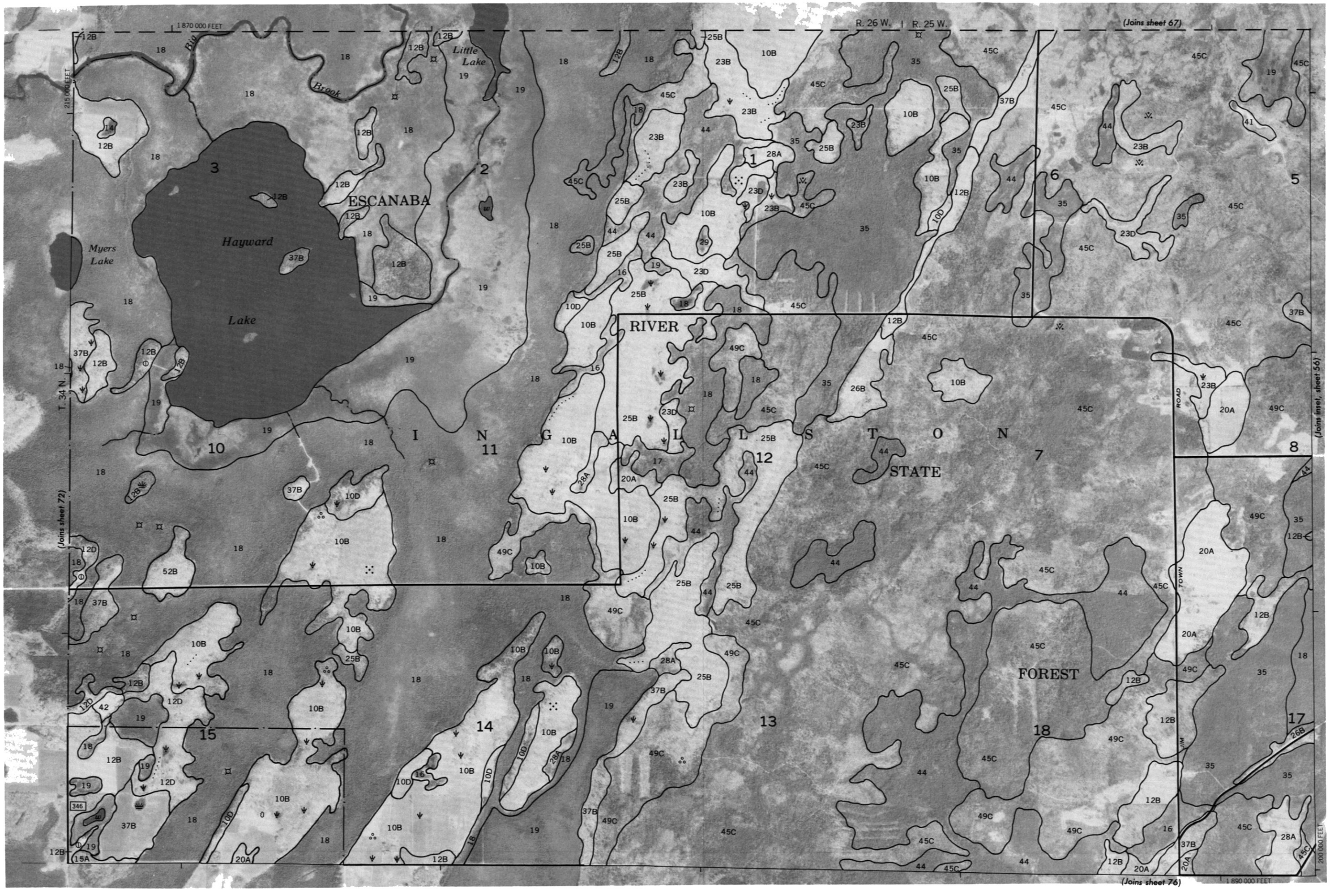


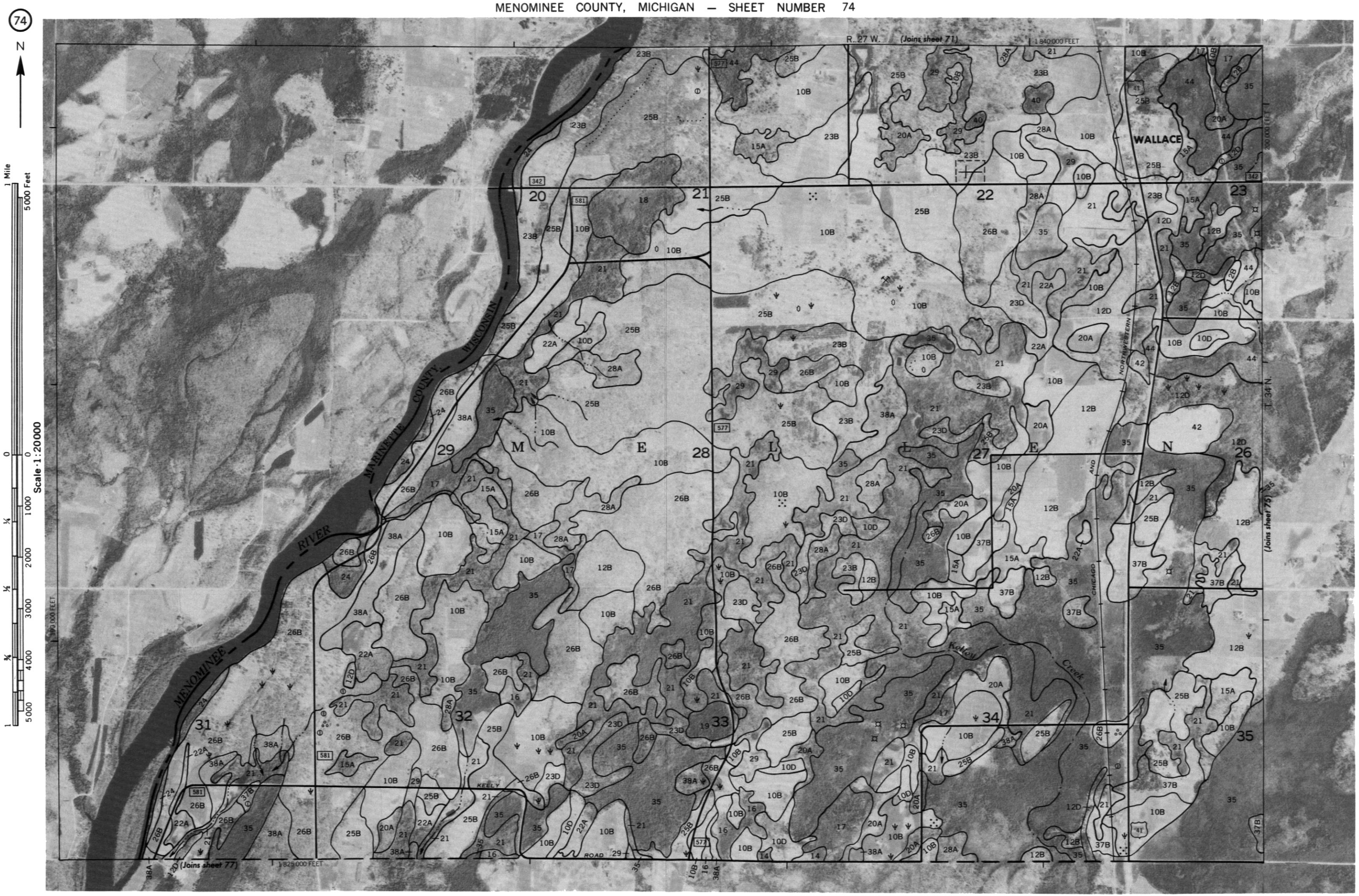
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 72

MENOMINEE COUNTY, MICHIGAN NO. 73

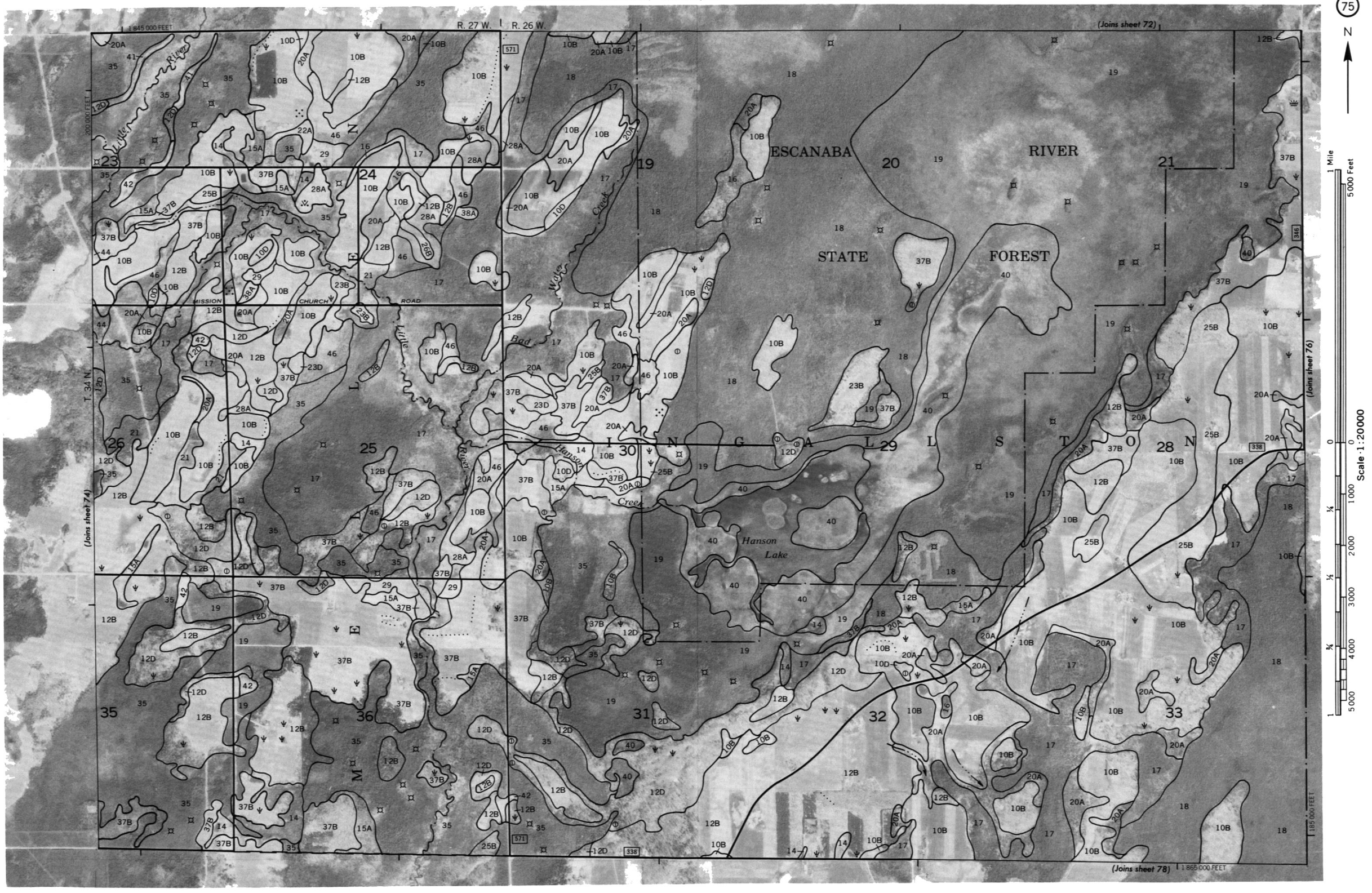
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 74



MENOMINEE COUNTY, MICHIGAN NO. 75

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

76

N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 79)

R. 26 W. | R. 25 W.

1 890 000 FEET

185 000 FEET

1 870 000 FEET

T. 34 N.

(Joins instl. sheet 68)

ESCANABA RIVER

INGALLS TOWNSHIP

STATE FOREST

GREEN BAY

ARTHUR BAY

BEACH GROVE

Rouchereau Point

Frontier Creek

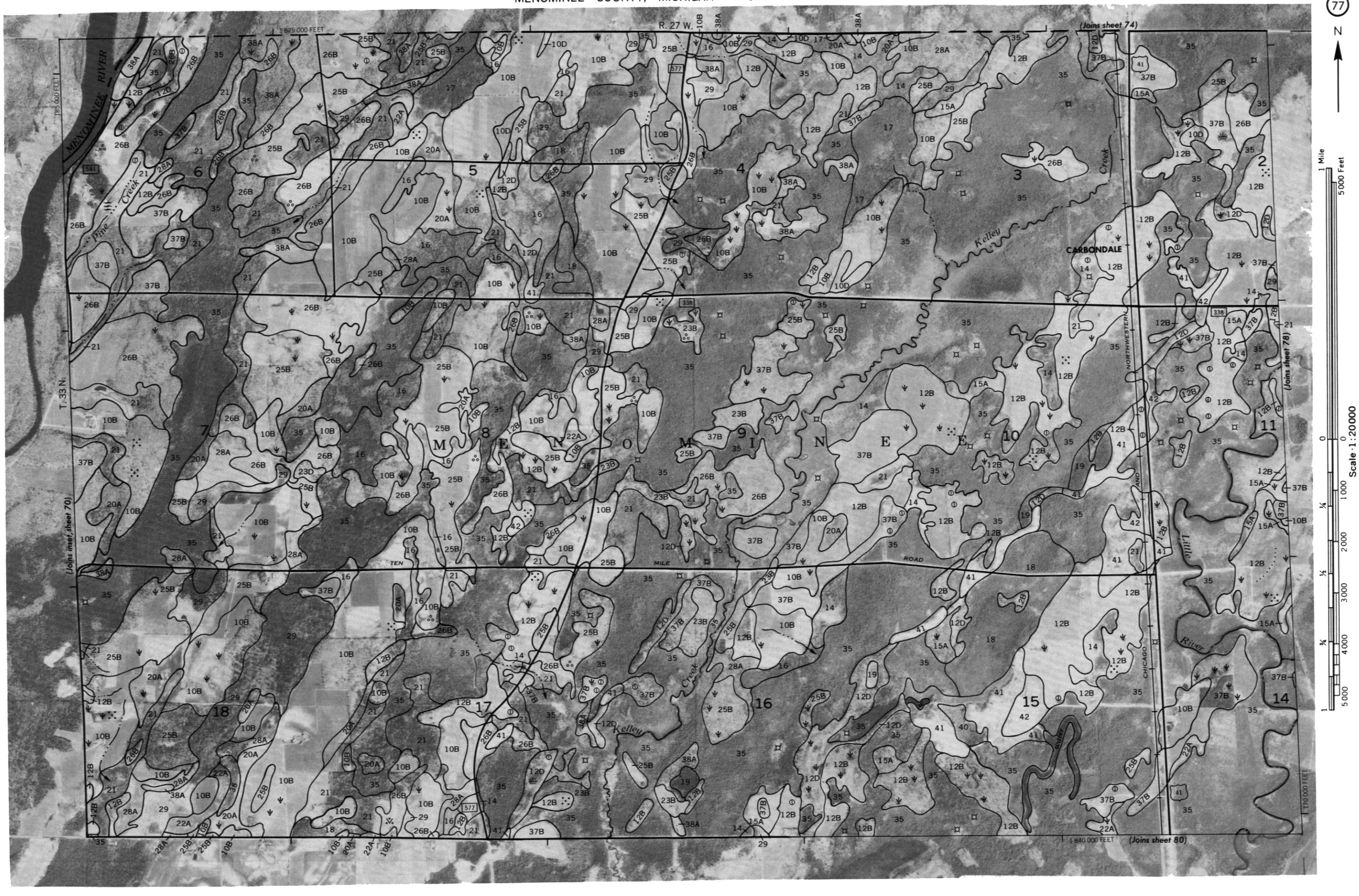
Rouchereau Creek

22 23 24 19 20 27 26 25 30 34 35 36 31

346 338 35

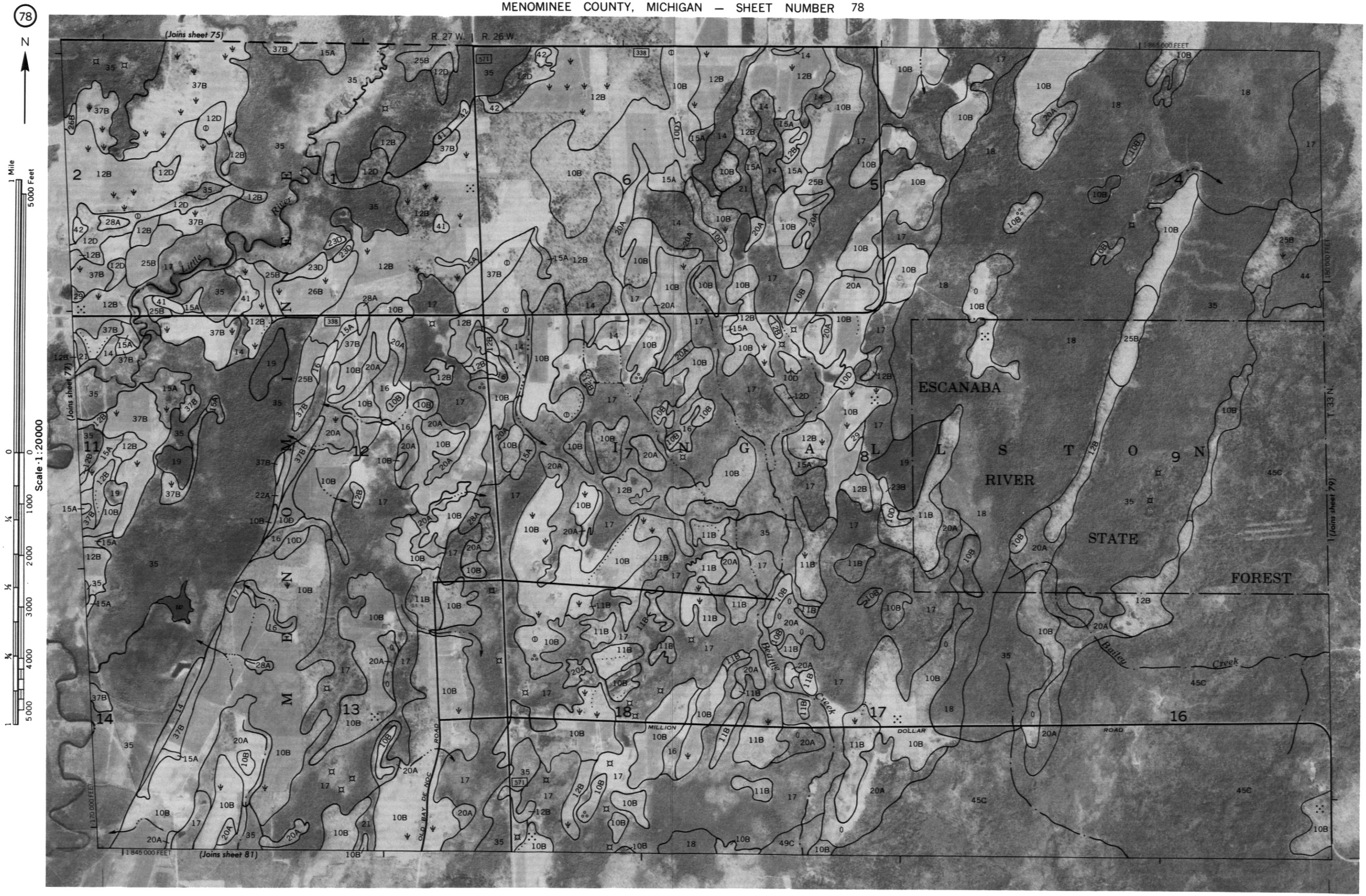
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 76



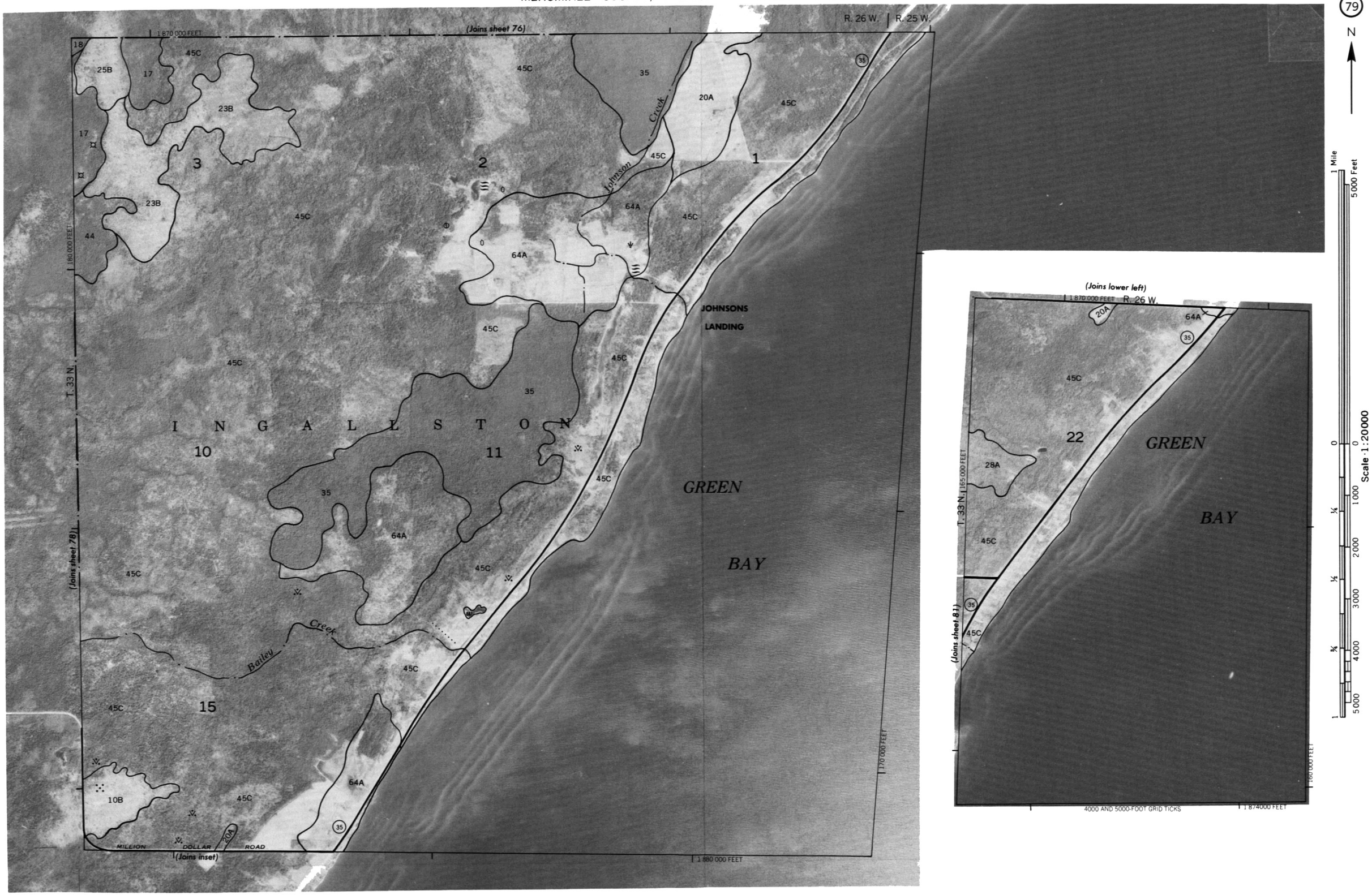
MENOMINEE COUNTY, MICHIGAN NO. 77

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 78



MENOMINEE COUNTY, MICHIGAN NO. 79

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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MENOMINEE COUNTY, MICHIGAN NO. 80

MENOMINEE COUNTY, MICHIGAN NO. 81

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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MENOMINEE COUNTY, MICHIGAN NO. 82

MENOMINEE COUNTY, MICHIGAN NO. 83

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

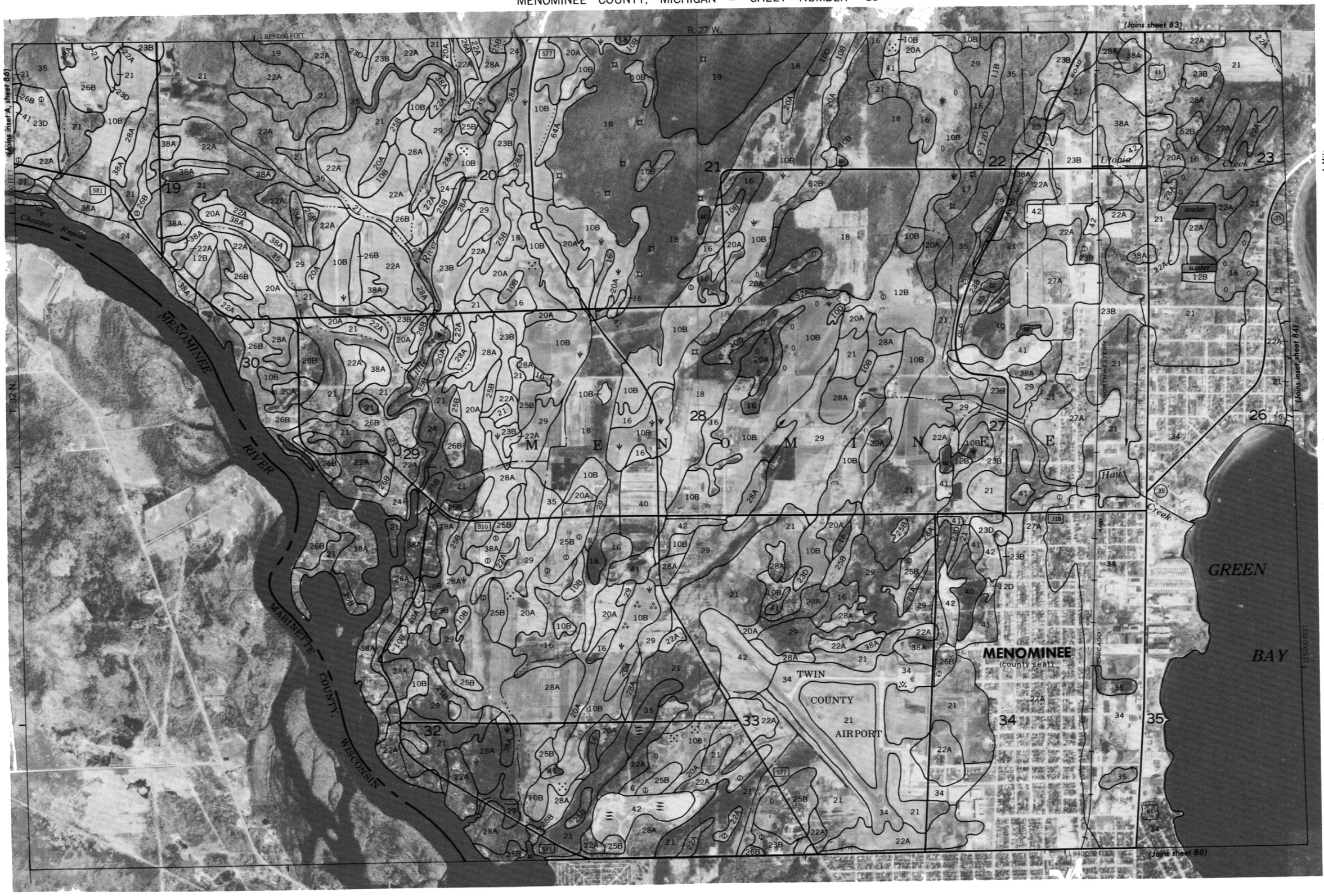
(Joins sheet 80)
(Joins sheet 82)
(Joins sheet 84)
(Joins sheet 85)

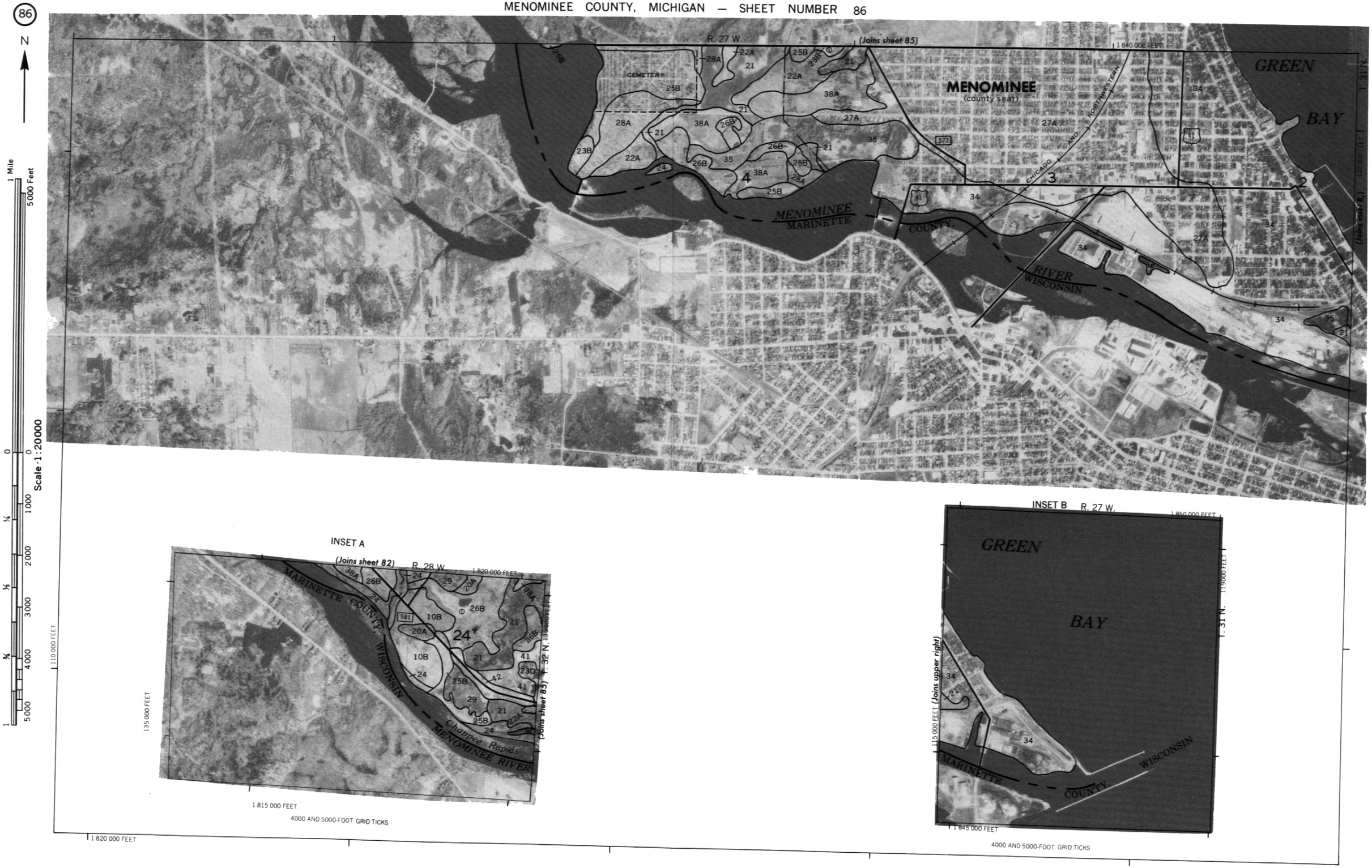
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MENOMINEE COUNTY, MICHIGAN NO. 84

MENOMINEE COUNTY, MICHIGAN NO. 85

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.